Vera Effigies Gulielmi Leybourn, Philom. anno Ætatis 30

R. Gaywood fecit

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ARITHMETICK,
VULGAR, DECIMAL, AND INSTRUMENTAL.

In Three Parts.

Containing

I *Vulgar Arithmetick*, Both in whole Numbers and Fractions, in a most plain and easie method.

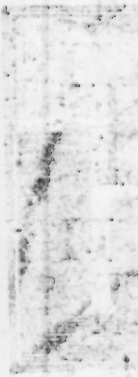
II *Decimal Arithmetick*, With the ground and reason thereof, illustrated by divers Examples, in all the most usual Rules of Arithmetick.

III *Instrumental Arithmetick* Exactly performing all Questions of what nature soever in a Decimal way, by Scales, with much more ease and facility then is possible to be effected either by Vulgar or Decimal Arithmetick, the work of Reduction being wholly avoided, and the Question performed without the use of Fractions: Nothing in this kind having been hitherto published by any.

Whereunto is added the construction and use of several Tables of Interest and Annuities, Weights and Measures, both of our own and other Countries.

By WILLIAM LEYBOURN

LONDON
Printed by *R.* and *W. Leybourn*, and are to be sold by *George Sambridge* at the Bible on *Ludgate*-hill, 1657



TO THE READER.

Here is presented unto thee a short Treatise *of* Arithmetick, *I confesse there are enough, (if not too many) already extant, notwithstanding I have* adventured *to publish this, more for* variety *than* necessity, not doubting but *in the perusal thereof thou shalt find something worth thy* Labour, *and what in other* Books *of this kind is wanting.*

mental Arithmetick, *which performeth any* Queſtion Arithmetical *in a* Decimal *way, without the help of* Tables, *by which the whole worke of* Reduction *is avoided, there being certain* Scales *of* Engliſh Money, Weight, *and* Meaſure, *by me contrived, by which (by inſpection only) the Decimal Fraction of either* Money, Weight, *or* Meaſure, *may be ſet down as exactly, and in leſſe time then they could have been taken out of the* DECIMAL TABLES in the Second Part of this TREATISE, *I have alſo in this Third Part, the*

(*the better to illuſtrate the uſe, and commodiouſneſſe of theſe* Scales, *a ſigne whereof is inſerted at* page 222,) *gone through all the moſt uſual* Rules *of* Arithmetick, *giving* Examples *in each* Rule, *by which the* Reader *may plainly perceive what labour there is ſaved by uſing the* Scales, *the whole work of* Reduction *being taken away, and the* Fraction *immediately ſet down at firſt, without* addition, *or being already ſet down,* reduced *to the known part of the* Integer, *without* Subſtraction.

Vnto theſe three parts there is added

an

an Appendix *containing certaine Rules of* Exchanges, *with* Tables *of the* Weight *and* Measures *of* forreign Countries *compared with the* VVeight *and* Measure *used in* London, *with an Example to illustrate the use of each* Table; *And lastly, there are* 5 *Tables calculated at* 6 per Cent. Compound interest, *by which the true valuation of any* Lease *or* Anuuity, *or* money forborn *or* rebated, *may be easily known, with an Example shewing the use of each Table.*

This Treatise thus finished, I present thee with, desiring thy friendly acceptance, and pardon for such faults as may possibly have escaped the presse, and in so doing thou wilt encourage him, who is

A friend to all that are Mathematically affected,

William Leybourn.

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AN Appendix containing divers Questions concerning Exchanges, of the Coyns, Weights and Measures of one Countrey, with those of another Countrey, with diverse Tables thereunto belonging, also Tables of Interest and Annuities at 6 per Cent. *Compound Interest.*

ERRATA.

Page 9, line 21 for *which* 2 read *which* 3, p. 42, *l.* 9 for *take* r. *make*, p. 44, l. 4. r. number, p. 155, l. 7, r. *the art of* p. 171, l. 3, for *quarts* r. *quarters*, p. 185, l. 7, r. 31 *li.* p. 227. l. 2, for *penny weight*, r. *grains.*

Numeration.

Numeration is accounted the first part of Arithmetick, and it is to know how to read a Summe of figures expressed in writing; or to write down any Summe to be expressed.

To the doing of which there are four things ecessary.

First, to kuow their number, which is Nine.

Secondly, their shapes, which are 1 2 3 4 5 7 8 9: of which the first toward the left hand ver signifieth One, the second Two, &c.

Thirdly, to know the value of their places.

Lastly, How their proper signification is al-red thereby.

The value of their places is thus, When two' hree, or more figures stand in one summe, that , without any Point, Line, or Comma betwixt

them, as 321, that place next the right hand where the figure 1 ſtandeth, is called the place of Unity, or Unities, and the figure 1 ſtandeth in that place only for one, and the figure 2 when it is found in that firſt place, ſtands only for two; and the like of the reſt.

But in the ſumme 321, above expreſſed, the figure 2 is in the ſecond place, and every place contains the value of that place before towards the right hand ten times; and therefore the figure 2 doth not ſignifie two, but (in this ſecond place) ten times two, that is Twenty. And ſo the figure 3 if it had been in that place had ſignified ten times three, that is Thirty; but being here in the third place it ſignifies ten times thirty, that is Three hundred: And ſo the whole Summe 321, is to be read, *Three hundred twenty* and *one*.

Fourthly, It is hereby ſeen, how their proper ſignifications, which were Three, Two & One, are altered by being thus placed, and the Sum, which otherwiſe had been but Six, is Three hundred twenty one, as before.

In like ſort, if there had been more places, as ſeven, the value is quite through increaſed ten times by being a place behinde towards the left hand; as in the Summe 1111111, The figure 1 in the ſecond place ſtands for ten times one (that is ten,) in the third for ten times ten (which is one hundred,) in the fourth for ten hundred (which is called one thouſand,) in the fift for ten thouſand, in the ſixt for ten

times

times ten thouſand (which is one hundred thouſand) in the laſt (here the ſeventh) place for ten hundred thouſand, which is called a Million: and ſo on, if there were more places, obſerving the ſame order.

Now to read this readily, make a prick over the place of Unity, another over the third from it, and over every third ſtill towards the left hand, for ſo thoſe points will be over the places of Unites, Thouſands, and Millions; and ſo beginning at the laſt, that is, at the left hand, read one Million, and becauſe the three following towards the right ſignifie properly one hundred and eleven, but the prick belonging to them is in the place of Thouſands, call them one hundred and eleven thouſand, and three remaining being under the point over Unity, ſignifie only one hundred and eleven; and all three points read together in one ſumme is, *One Million, one hundred and eleven Thouſand, one hundred and eleven.*

In like manner, if this number 73598624 were given to be read (according to former directions) make a prick over every third figure, beginning with the firſt figure towards the right hand (which is the place of Unity) and then will your number ſtand thus

73'598'624

Then for the ready reading thereof (becauſe the third prick ſignifieth Millions) call all the figures towards the left hand, ſtanding from that prick, Millions, which in this example are 7 and

3, ſo then this number contains 73 Millions, 598 Thouſand, 624, which in words at length we read, *Seventy three Millions, five hundred ninety eight thouſand, ſix hundred twenty four.*

Let thus much ſuffice concerning the placing of large numbers, for the ready reading of them, only take theſe four Tables following, for illuſtration of what hath been hitherto delivered in words, the very ſight whereof is better then a whole Chater of information.

The firſt Table is thus to be read] One in the firſt place ſignifies One. One in the ſecond place ſignifies Ten. One in the third place ſignifies a hundred, &c. as in the Table.

The ſecond Table is thus to be read] In this Table you ſhall find the laſt number thereof to conſiſt of theſe figures, 357.846.903 with a point or comma betwixt every third figure, for diſtinction ſake, and alſo every three figures in their order are connected together with this ⏜ brace, which denominate the places of Millions, Thouſands, Hundreds, ſo that the laſt number of this Table will evidently appear to be 357 Millions, 846 Thouſands 903.

The third Table is only certain rowes of figures ſet together and orderly diſpoſed, having the ſignification or reading of the ſame numbers in words at length to them annexed, and is only inſerted for the ſatisfaction of ſuch as ſhall doubt whether they perfectly underſtand what hath been before taught.

The fourth Table is much like the ſecond only it conſiſteth but of one number and extends three

three places farther then the greateſt number in the ſecond Table doth: viz. to twelve places which figures are thus to be read. 736 Millions of millions, 842 Millions, 708 Thouſand, 645.

(1 Table)

One in the	place ſignifies
first	1 one
ſecond	10 ten
third	100 a hundred
fourth	1000 a thouſand
fifth	10000 ten thouſand
ſixth	100000 a hundred thouſand
ſeventh	1000000 a million
eigth	10000000 ten millions
ninth	100000000 a hundred millions

(2 Table)

millions			thouſds			hundreds		
								8
							5	4
						7	6	2
					3.	4	8	3
				9	7.	6	2	1
			2	4	3.	7	9	4
		8.	7	4	9.	8	0	7
	5	7.	3	1	6.	2	4	8
3	5	7.	8	4	6.	9	0	3

(3 Table)

number of places		
1	8	(eight,
2	5 4	(fifty four,
3	7 6 2	(seven hundred sixty two,
4	3 4 8 3	(three thousand, four hundred eighty three
5	9 7 6 2 1	(ninety seven thousand, six hundred twenty one
6	2 4 3 7 9 4	(two hundred 43 thousand 7 hundred 94
7	8 7 4 9 8 0 7	(eight millions, 749 thous. 8 hund. and 7
8	5 7 3 1 6 2 4 8	(fifty seven mil. 3 hund. and 16 thous. 248
9	3 5 7 8 4 6 9 8	(3 three hundred fifty seven millions, eight
	9 0 7	(hundred 46 thous. 9 hund. and 3.

(4 Table)

7	hundred	millions of millions
3	ten	
6	one	
8	hundred	millions
4	ten	
2	one	
7	hundred	thousands
0	ten	
8	one	
6	hundred	hundreds
4	ten	
5	one	

Addition.

ADdition is the collecting or gathering together of two or more ſums, either of one or of diverſe denominations, into one ſum, which is called the (*Aggregate*) (*Totall*) or (*Groſſe ſum.*)

In Addition of numbers of one denomination, the order is to ſet the numbers to be added one directly under the other, that is to ſay Unites under Unites, Tens under Tens, Hundreds under Hundreds, &c.

The Rule.

Having placed your numbers to be added in due order, one under another, draw a line under them, and begin at the lowermoſt figure towards your right hand, and adde that to the next figure above, and the ſum of them to the next figure above that, proceeding in this order till you have added the whole line together, which when you have done, conſider how many tens are contained in that line, and for every ten keep one unite in yonr mind, to be added to the next row, but if there be any odde digits, you muſt ſet them beneath the ſtroake, juſt under the line you added together, ha-

ving thus finiſhed the addition of one line proceed to the next, and from thence to the third, and ſo forward, be there never ſo many. The Examples following will make this plain.

Example 1. Let the numbers given to be added together be 7832, 5609, 276, 8547, having thus placed them in order one under another as in the Margine is done, draw a line under them, then begin your addition, at the lowermoſt figure towards your right hand, ſaying, 7 and 6 is 13, and 9 is 22, and 2 is 24 now becauſe in 24, there is two tens, and 4 remaining, I place the 4 under the line, and carry the two tens to the next row, ſaying, 2 which I carryed and 4 makes 6, and 7 makes 13, and 3 makes 16, in which row there is but one ten contained and 6 remaining, which 6 I ſet under the line, and carry the ten to the next row of hundreds, ſaying, 1 that I carryed and 5 makes 6, and 3 makes 9, and 6 makes 15, and 8 makes 23, in which 23, ten is contained two times, and 3 remaining, the 3 I place under the line, and carry the two tens to the next row, ſaying 2 which I carryed and 8 makes 10, and 5 makes 15, and 7 makes 22, in which ten is contained two times, and 2 remaining, which 2 I ſet under the line, and becauſe there is never another

Thouſands	Hundreds	Tens	Unites
7	8	3	2
5	6	0	9
	3	7	6
8	5	4	7
2 2	3	6	4

ther row to be added (to which I ſhould carry the two tens) I therefore ſet it down alſo under the line towards the left hand, as you ſee done in the margent, ſo the totall or groſſe ſum of theſe numbers being added together is 22364.

Example, 2. A man hath in his Orchard 136 Apple trees 76 Pear trees, 107 Cherry trees, and 36 Plum trees, and he deſires readily to know how many trees he hath in all, place your numbers one under another as in the margine, and then begin to adde them together, at your right hand, ſaying, 6 and 7, make 13, and 6 make 19, and 6 makes 25, place 5 under the line, and carry 2 to the next row, ſaying 2 and 3 is 5, and 7 is 12, and 3, is 15, place 5 under the line, and carry 1 to the next row, ſaying 1 and 1 is 2, and 1 is 3 which I ſet under the line, & becauſe there was no tens contained in that line therefore the totall is 355, and ſo many Trees are in the Orchard.

Apple trees	136
Pear trees	76
Cherry trees	107
Plum trees	36
Trees in all	355

Other Examples for Practice:

95432	321	9161
76100	1986	235
2570	23	72
832	1107	9
Tot. 174934	Tot. 3437	Totall 9477

Addition of numbers of diverſe Denominations.
1 *Addition of Engliſh Money.*

The moſt uſuall Coyns uſed in *England* are Pounds, Shillings, Pence and Farthings, of which Coyns

4 Farthings	make	1 Peny	thus charactred	*d.*
12 Pence	make	1 Shilling	thus charactred	*s.*
20 Shillings	make	1 Pound.	thus charactred	*li.*

for a farthing we uſe *q*:

THE RULE.

In the addition of numbers of diverſe denominations this order is to be obſerved, *viz. Place all numbers of the ſame denomination one directly under another, as Pounds under pounds, ſhillings under ſhillings, pence under pence, and farthings under farthings. Then draw a line under them, and begin your Addition with the leaſt denomination firſt, obſerving how many times the next greater denomination is contained in the leaſt, and for every time carry one unite to the next denomination, as before you did the tens, ſetting down the remainder if any be, then adding the next denomination together take notice how many times the next greater denomination is contained in that leſſer, carrying for every time one to the next,* thus

thus proceeding till you have gone over all the denominations, be they never ſo many.

Example 1 Let the numbers to be added together be 37 *li.* 16 *s.* 9 *d.* 3 *q.* 21 *li.* 9 *s.* 8 *d.* 1 *q.* 13 *li.* 12 *s.* 9 *d.* 2 *q.* Place the numbers as in the margine, draw a line under them, and begin with the leaſt denomination (which in this example is farthings) firſt, ſaying, 2 *q.* aud 1 *q.* is 3 *q.* and 3 *q* is 6 *q.* which is one penny and 2 *q* remaining, which 2 *q* I place under the line, and carry the one peny to the next row which is the place of pence, ſaying, one peny and 9 *d.* is 10 *d.* and 8 *d.* is 18 *d.* which is 1 *s.* and 6 *d.* (*Now againſt the* 8 *I make a prick with my pen for my better remembrance to ſignifie that there is one ſhilling to be carryed to the place of ſhillings,*) then go on and ſay, 6 *d.* and 9 *d.* is 15 *d.* which is 1 *s.* and 3 *d.* therefore againſt 9. I make a prick with my pen, and (becauſe that is the laſt number) I ſet down the odde 3 *d.* under the place of pence, and (becauſe I find two pricks in the line of pence, therefore) I carry 2 *s.* to the place of ſhillings, ſaying 2 *s.* which I carryed, and 12 *s.* is 14 *s.* and 9 *s.* is 23 *s.* which is one pound and 3 *s.* remaining, I make a prick againſt 9, and going on, ſay 3 *s.* and 16 *s.* is 19 *s.* which (being there is no more numbers to be added, and being alſo leſſe then 20 *s.*) I ſet under the line, and finding one prick in the line of ſhillings, I therefore car-

li.	*s.*	*d.*	*q.*
37	16	9.	3.
21	09.	8.	1
13	12	9	2
72	19	3	2

ry

ry one to the place of pounds, saying, one which I carryed and 3 is 4, and 1 is 5, and 7 is 12, set down the 2 under the line (as in addition of numbers of one denomination) and carry one to the next row, saying 1 that I carryed and 1 is 2, and 2 is 4, and 3 is 7, which being the last I set down, and so the totall or grosse sum is 72 *li.* 19 *s.* 3 *d.* 2 *q.*

Example 2 Let the numbers to be added be 29 *l.* 16 *s.* 8 *d.* 32 *l.* 17 *s.* 9 *d.* 81 *l.* 13 *s.* 11 *d.* & let it be required to find the Totall or grosse Sum. Here in this Example the least denomination is pence, therefore I begin with them, and say 11 *d.* and 9 *d.* is 20 *d.* which is 1 *s.* and 8 *d.* make a prick against the 9 and say 8 *d.* and 8 *d.* is 16 *d.* that is 1 *s.* and 4 *d.* make a prick against the 8 and set down the odde 4 *d.* then (becuse there are two pricks in the line of pence) you must carry 2 *s.* to the place of shillings, saying 2 *s.* which I carry and 13 *s.* is 15 *s.* and 17 *s.* is 32 *s.* which is 1 *li* 12 *s.* make a prick against 17, and say 12 *s.* and 16 *s.* is 28 *s.* make a prick against 16, and (because there is no more numbers to be added) set down the odde 8 *s.* under shillings, and (being there is two pricks in the line of shillings) carry 2 to the place of pouuds, saying 2 and 1 is 3, and 2 is 5, and 9 is 14, set down 4 and carry 1 to the next line, and say 1 and 8 is 9, and 3 is 12, and 2 is 14, which (because

li.	*s.*	*d.*
29	16.	8.
32	17	9.
81	13	11
144	8	4

cauſe it is the laſt) you muſt ſet down, ſo is the totall or groſſe ſum 144 *li.* 8 *s.* 4 *d.*

Other Examples for Practice.

li.	*s.*	*d.*	*q.*
29	18.	7	3
63	11.	2.	1.
129	4	0	2
3	7	10	1
226	1	8	3

li.	*s.*	*d*
36	2	8.
29	0	2
31	16.	9.
6	2	5
103	2	0

2 *Addition of Troy Weight.*

Troy weight is a Weight uſed in *England*, by the which is weighed, *Bread*, *Gold*, *Silver*, *Pearl*, &c. the moſt uſuall denominations of which weight are, *Pounds*, *Ounces*, *Peny weights*, and *Grains*, of which

24 Grains } make { 1 Peny weig. } thus charcted { *pw.*
20 Peny weight } make { 1 Ounce } thus charcted { *ou.*
12 Ounces } make { 1 Pound } thus charcted { *lib*

for a graine we write *gr.*

The Addition of Troy weight (and conſequently of any other weight or meaſure whatſoever either Domeſtique or Forreign) differeth nothing at all from the adddition of Coine laſt taught

taught, if the affinity of one denomination to an other be firſt known, for whereas in money becauſe 12 *d.* make 1 *s.* you therefore obſerve how many twelves there are in the addition of your pence, and for every 12 you adde one ſhilling to the place of ſhillings, ſo in the addition of Troy weight, knowing that 24 *gr.* make one peny weight, you muſt therefore in the addition of Grains of Troy weight obſerve how many times 24 you finde in your line of Grains and for every 24, carry one to the place of peny weights, likewiſe in the addition of peny weights Troy, you muſt conſider how many times 20 is contained in your line, and for every 20 carry one to the place of ounces, (becauſe 20 peny weight make an ounce.) Alſo in the addition of Ounces Troy, you muſt obſerve how many times 12 you find in your line of ounces, and for every 12 carry one to the place ofpounds then laſtly adde your pounds together, as numbers of one denomination.

Example. Let the numbers to be added together be 7 *li.* 11 *ou.* 13 *pw.* 19 *gr.* 6 *li.* 7 *ou.* 16 *pw.* 19 *gr.* 3 *li.* 7 *ou.* 9 *pw.* 6 *gr.* Place your numbers as in addition of money, each under other according to their reſpective denominations, as in the margine, then draw a line under them, and begin your Addition with the leaſt denomination firſt, *viz.* grains ſay-

li.	*ou.*	*pw*	*gr:*
7	11.	13	19
6	07.	16.	19.
3	07	09	06
18	02	19	20

ſaying, 6 *gr.* and 19 *gr.* is 25 *gr.* which is one peny weight and one grain, make a prick againſt 19, and carry the odde grain to the number above, ſaying 1 *gr.* and 19 *gr.* is 20 *gr.* which (becauſe it is leſſe then one peny weight) I ſet under the line, then finding one prick in the line of grains, I (therefore) carry one to the place of peny weights, ſaying 1 and 9 is 10, and 16 is 26, which is one ounce, and 6 *pw.* make a prick againſt 16, and ſay 6 and 13 is 19, which (being leſſe then an ounce) ſet under the line, then for the one prick, carry 1 to the place of ounces, ſaying 1 and 7 is 8, and 7 is 15, which is one pound and 3 *ou.* make a prick at 7, and ſay 3 and 11 is 14, which is one pound and 2 ounces, ſet down the 2 ounces and for the two pricks carry 2 pounds to the place of pounds, ſaying 2 and 3 is 5, and 6 is 11, and 7 is 18, which ſet under the place of pounds, ſo is your addition ended, and the ſum is 18 *li.* 2 *ou.* 19 *pw.* 20 *gr.*

Other Examples for Practice.

li.	*ou.*	*pw*	*gr.*
32	9.	12	16
17	11.	6	9.
34	8.	15.	10
8	10	4	7
94	3	18	18

li.	*ou.*	*pw*	*gr.*
0	10	17.	11
0	6.	0	5
0	0	16	8.
0	5	2	19
1	10	16	19

3 *Addition of Avoirdupois little Weight.*

There is another kind of weight moſt commonly uſed in *England* called Avoirdupois little weight, by whirh is weighed all ſorts of wares or merchandiſe Garblable, as *Suger*, *Pepper*, *Cloves*, *Mace*, *&c.* This weight is commonly divided into theſe denominations, *Pounds*, *Ounces*, *and Drams*, of which

16 Drams } make { 1 Ounce } thus charact. { *ou.*
16 Ounces } make { 1 Pound } thus charact. { *li.*
for a dram we write *dr.*

In the addition of Avoirdupois weight, you muſt obſerve the very ſame method and order as in Money and Troy weight, having due reſpect to the quantity of the denomination, as in the addition of drams to make a prick at every 16, ſetting down the remainder and for every prick carrying a unite to the next place. The preceding rules being ſo copious in this particular I ſhall forbear to make any verball illuſtration, but ouly give you ſome examples ready wrought, together with the moſt uſual parts into which the Weights and Meaſures now uſed in *England* are divided into: which to the ingenious will be of moſt validity.

Examples

Examples of Addition of Avoirdupois little weight.

li.	*ou.*	*dr.*
12	11.	09
76	05	12.
32	10.	00
91	07.	13.
32	13	07
246	00	09

li.	*ou.*	*dr.*
06	13.	07.
05	09.	12
06	03	09.
10	00	00
05	07	09
34	02	05

4 *Addition of Avoirdupois great weight.*

There is a weight commonly uſed in *England*, by which is weighed all commodities that are ſold by the hundred, as Corents, Wool, Fleſh, Butter, Cheeſe, and the like, the which hundred weight containeth 112 pounds, and the hundred weight is divided into quarters, pounds, and ounces, ſo that

16 Ounces, 28 Pounds, 4 quarters } makes { 1 Pound, 1 quarter of a C., 1 Hundred weig. } thuscharactred { li., qr., C.

for an Ounce we write *oz.*

Examples of Addition of Avoirdupois great Weight.

C.	*qr.*	*li.*	*ou.*	*C.*	*qr.*	*li.*	*ou.*
37	03.	21	12.	05	1.	00	07
09	01	06	03	03	2	18	06
33	02	20.	00	00	1	06	08
10	00	00	00	11	3.	04	00
12	03.	07	03	06	1	10	05
103	02	27	02	27	1	11	10

I might further proceed to ſhew you Examples of addition of common Engliſh meaſures, *viz.* of long meaſures, Liquid meaſures, and dry meaſures, as alſo of Time, Motion, &c. but the preceding Examples being of ſufficient extent, I ſhall forbear to trouble either my ſelfe or the Reader with that which I conceive ſuperfluous: Only, before I leave Addition, I will give you a brief view, of the moſt uſual meaſures *England*, which take as followeth. And

1 *Of Liquid Meaſures.*

Liquid meaſures are thoſe in which all ſorts of Liquid ſubſtances are meaſured, of which (according to the Statute of 12 *Hen.* 7. *chap.* 5.) a Pinte is the leaſt, from which the greater Liquid meaſures are deduced, according as is expreſſed in the Table following.

2 Pintes

2 Pintes	make	1 Quart
2 Quarts		1 Pottle
2 Pottles		1 Gallon
8 Gallons		1 Firkin of Ale, Sope, or
9 Gallons		1 Firkin of Beer (Herings
10 ½ Gallons		1 Firkin of Salmon or Eels
2 Firkins		1 Kilderkin
2 Kilderkins		1 Barrell
42 Gallons		1 Tierce of Wine
63 Gallons		1 Hogſhead
2 Hogſheads		1 Pipe or But
2 Pipes or Buts		1 Tun of Wine.

2 *Of Dry Meaſures.*

Dry Meaſures are theſe in which all kind of dry ſubſtances are meaſured, as *Corn, Salt, Cole, Sand, &c.* of which a pinte is the leaſt.

2 Pintes	make	1 quart
2 quarts		1 Pottle
2 Pottles		1 Gallon
2 Gallons		1 Peck
4 Pecks		1 Buſhel Land meaſure
5 Pecks		1 Buſhel Water meaſure
8 Buſhels		1 quarter
4 quarters		1 Chaldron
5 quarter		1 Wey.

3 *Of Long Meaſures.*

Long Meaſure is that by which is meaſured *Cloth, Land, Board, Glaſſe, Pavement, Tapeſtry, &c.*

of which measures (according to the Statute of 33 *Ed.* 1. and 25 *El.*) a *Barley corn* is the least. So that

3 Barley Corns	make	1 Inch
12 Inches		1 Foot
3 Foot		1 Yard
3 Foot 9 inches		1 Ell
6 Foot		1 Fadome
5 ½ Yards, or 16 ½ Foot		1 Pole or Perch
40 Perches		1 Furlong
8 Furlongs		1 Englisſh mile.

4 *Of Time.*

Time conſiſteth of *Years*, *Moneths*, *Weeks*, *Dayes*, *Houres*, and *Minutes*. So that

60 Minutes	make	1 Houre
24 Hours		1 day naturall
7 Dayes		1 Weeke
4 Weeks		1 Moneth of 28 days
13 Moneths, one day 6 houres		1 Yeare.

4 *Of Apothecaries Weights*

The weights uſed by Apot ocaries are *Grains*, *Scruples Drams*, and *Ounces* f which

20 Grains

20 Grains		1 Scruple		℈
3 Scruples	make	1 Dram	thus charac.	ʒ
8 Drams		1 Ounce		℥
12 Ounces		1 Pound		*li.*

By help of theſe Tables and the rules and cautions before expreſſed any man may make addition of any of the aboveſaid meaſures one with another, and therefore I ſhall forbear to illuſtrate them by Examples, but leave them to every mans own practice, and thus I conclude Addition.

The Proof of Addition.

Having placed your numbers in order, and added them together and ſet the Totall under the line, cut off the upper number by drawing a line with your pen betwixt that and the others, then adde all the numbers together except the uppermoſt, and ſet the Totall of them under the Totall before found, then adde this laſt Totall, and the firſt number which you cut off with your pen together, and if the ſum of thoſe two numbers be equall with your Totall ſum firſt found, then 's your worke right, otherwiſe not.

Exomple. In the firſt example of whole numbers, the ſums to be added were 7833, 5609, 376, and 8547 theſe numbers placed in due order and added together, The totall or groſſe ſum of them is 22364, now to prove whether this

Totall be true or not, I cut off the uppermoſt number, (to wit 7832) with a daſh of the pen, and I adde the other three numbers together, namely, 5609, 376, and 8547, and the Totall of them is 14732, which number being added to 7832 (the number cut off) the ſum of them is 22364 exactly agreeing with the Totall firſt found, cleerly evidenceth that the addition was truly performed; but if they had diſagreed then the worke had been erroneous. The like courſe muſt be taken for the proof of thoſe ſums which have different denominations as in Money and Weight, as by the examples following will appear.

	7832
	5609
	376
	8547
firſt Total	22564
laſt Total	14532
Proofe	22364

Other Examples proved.

1 *Example of Money*

	li.	*s.*	*d.*	*q.*
	37	16	9	3
	21	9	8.	1
	13	12	9	2
1 Total	72	19	3	2
2 Total	35	2	5	3
Proof	72	19	3	2

2 *Example of Troy Weig.*

li.	*ou.*	*pw*	*gr.*
32	9	12	16
17	11	6	9
34	8	15	10
8	10	4	7
94	3	18	18
61	6	6	2
94	3	18	18

There

There are other wayes to prove Addition, by casting away of all the nines in numbers of one denomination, and of all the twelves, twenties; and nines, in pounds shillings and pence, &c. but this as the most certaine and easie I embrace, and thus much for Addition and the proofe thereof.

Sub-

Subtraction.

Subtraction is the taking of one or more ſmall ſums out of a greater, as 7 *s.* out of 12 *s.* or 37 *li.* out of 100 *li.* or 137 foot out of 983 foot and the like.

As in Addition the ſums to be Added may be either of one or of diverſe denominations, ſo likewiſe they may be in Subtraction, and the manner of placing them is the ſame, for you muſt ſet Unites under Unites, Tens under Tens, Hundreds under Hundreds, &c.

Example 1 Of Subtraction of numbers of one denomination, let it be required to ſubtract 234, out of 986, place the numbers one under the other as as you ſee done in the Margine, draw a line under them, and begin with the firſt figure towards your right hand, which is 4, ſaying take 4 from 6, and there remains 2, place 2 under the line, and go to the next figure which is 3, ſaying, take 3 from 8, and there remains 5, place 5, under the line, and go to the next figure which is 2, ſaying take 2 out of 9, and there remains 7, place 7 under the line, and your ſubſtraction is ended, and it is evident by the work, that

number given	986
number to beſubtracted	234
remainder	752

that if you take 234 out of 986 there will remain 752, which you may thus prove, for if you adde the 234 to 752, you ſhall find the ſum of that addition to be 986, which is equall to the whole ſum from which 234 was ſubtracted.

Example 2. Let it be required to ſubtract 2976 out of 96527, place the numbers one under another as in the margine you ſee done, then draw a line uuder them, and beginning with the firſt figure towards your left hand, ſay take 6 out of 7, and there remains 1, place 1 under the line and proceed to the next figure, ſaying 7 out of 2 I cannot (wherefore you muſt alwayes adde 10 to the number above which in this example is 2 and it makes it 12,) therefore take 7 out of 12, and there remains 5, place 5 under the line, and (becauſe you added 10 to the 2 to make it 12, you muſt) carry a unite to the next figure, ſaying, one which I carryed and 9 is 10, take ten out of 5, which I cannot, therefore I muſt adde 10 to 5 and it makes 15, and ſay 10 out of 15, and there remains 5, place 5 under the line, and becauſe you added 10 to 5 to make it 15, you muſt therefore carry a uuite to the next figure, ſaying, one which I carried, and 2 is 3, take 3 out of 6 and there remains 3, place 3 under the line, and becauſe there is no more figures to be ſubtracted from the number above you muſt, ſay nothing from 9 and there remains 9, ſet the 9 under the line, and your Subtraction is ended.

9	6	5	2	7
	2	9	7	6
9	3	5	5	1

Other

Other Examples for practice.

	li.	*reams of Paper*		*ſheep*
Lent	5762	bought 9765	from	1000
Paid	378	ſold 6529	take	394
Reſts to pay	5384	unſold 3236	remains	606

Subtraction of Numbers of diverſe Denominations

1 *Of Engliſh Money.*

In Subtraction of numbers of diverſe denominations you muſt obſerve the ſame order as in Addition, namely, to place every number in due order with reſpect to its denomination, as pounds under pounds, ſhillings under ſhillings, &c, the greater number alwayes uppermoſt, and drawing a line under them, begin with the leaſt denomination firſt, ſubtracting it from the line above, and ſetting the remainder under the line as in whole numbers, but if the pence or ſhillings in the upper row be ſmaller then thoſe in the neather row, you muſt add 12 d. or 20 s. to the ſmaller number, that ſo ſubtraction may be made, as by the examples following will appear.

Example 1. Let it be required to ſubtract 38 *li.* 12 *s.* 8 *d.* out of 269 *l.* 18 *s.* 10 *d.* Place your numbers as in the margine, then beginning with the leaſt denomination firſt,

	li.	*s.*	*d.*
Lent	269	18	10
Paid	38	12	8
reſts	231	6	2

(which

(which in this Example is pence) ſay 8 *d.* from 10 *d.*, and there remains 2 *d.* ſet the 2 *d.* under the line, and proceed to the next denomination which is ſhillings, ſaying take 12 *s.* out of 18 *s.* and there remains 6 *s.* place 6 *s.* under the line, and go to the pounds, ſaying 8 out of 9 and there remains 1, place 1 under the line, and ſay 3 out of 6, and there remains 3, then (becauſe there is no more figures to be ſubtracted) ſay nothing out of 2 and there remains 2, which ſet under the line, ſo is your ſubtraction ended, and the remainder is 231 *li.* 6 *s.* 2 *d.*

Example 2. Let it be required to ſubtract 2628 *li.* 16 *s.* 10 *d.* out of 9320 *li.* 10 *s.* 7 *d.* place the numbers in order, and beginning with the pence, ſay 10 *d.* out of 7 *d.* I cannot, (therefore I muſt adde 12 *d.* (which is one ſhilling) to 7 *d.* and it makes 19 *d.*) but 10 *d.* out of 19 *d.* and there remains 9 *d.* ſet the 9 *d.* under the line, and (becauſe I added 12 *d.* to 7 *d.*) I muſt therefore carry one to the place of ſhillings, ſaying 1 *s.* which I carryed, and 16 *s.* is 17 *s.* then 17 *s.* from 10 *s.* I cannot take, therefore, I muſt add 20 *s.* (which is one pound) to 10 *s.* and it makes 30 *s.* and 17 *s.* out of 30 *s.* and there remains 13, ſet 13 under the line, and carry one to the place of pounds, ſaying one which I carried and 8 is 9, take 9 of 0 I cannot, but 9 out of 10, and there remains

	li.	*s.*	*d.*
Lent	9320	10	07
Paid	2628	16	10
Reſts	6691	13	8

remains 1, ſet 1 under the line and carry a unite to the next place, ſaying 1 which I carried and 2 is 3, take 3 out of 2 I cannot, but 3 out of 12, and there remains 9, place 9 under the line and carry 1 to the next place, ſaying 1 which I carry and 6 is 7, take 7 out of 3 I cannot, but 7 out of 13 and there remains 6, place 6 under the line, and carry one to the next row, ſaying one and 2 is 3, take 3 from 9 and there remains 6, place 6 under the line, ſo is your Subtraction ended, and the remainder is *6691 li. 13 s. 9 d.*

Example 3 Suppoſe a man had lent to another man 1000 pound, and that the borrower had paid thereof at one time 127 *li.* at another time 430 *li.* 10 *s.* and at a third payment 50 *li.* and the creditor would know how much he hath received and how much is owing of his debtor.

Place the numbers as here you ſee, firſt the ſum of money lent, and draw a line under it, then ſet the ſums paid at ſeverall times one under another and draw a line under them. Then adde all the ſums which have been paid at ſeverall times together which make 607 *li.* 10 *s.* which is the ſum which the debtor hath paid in all,

	li.	*s.*	*d.*
Money lent	1000	00	00
	127	00	00
paid at ſeve-	430	10	00
rall times	50	00	00
paid in all	607	10	00
reſts to pay	392	10	00

all, then ſubtract this 607 *li.* 10 *s.* from 1000 *li.* and there will remain 392 *li.* 10 *s.* and ſo much is ſtill owing to the Creditor.

Other Examples for practice.

	li.	*s.*	*d.*
Lent	2601	13	6
Paid	98	7	9
Reſts	2503	5	9

	li.	*s.*	*d.*
Owing in all	100	00	00
Paid in all	36	10	06
Reſts to pay	63	9	6

	li.	*s.*	*d.*	*q.*
Lent	3625	16	08	03
Paid at ſeveral times	100	00	00	00
	336	10	06	02
	039	12	09	02
	100	00	00	00
Paid in all	576	03	04	00
Reſts to pay	3049	13	04	03

The Proof of Subtraction.

The Proofe of Subtraction it performed by Addition, for adding the number to be ſubtracted, to the remainder, the Sum of them muſt be equall to the number given, if you have truly wrought. As in the firſt example of numbers of one denomination,

the number given is	986
the number to be ſubtracted is	234
the remainer is	752
Proof	986

Adde

Adde the number to be ſubtracted 234, to the remainer 752, the ſum of them is 986, equall to the number given.

Examples for Practice proved.

	li.	*s.*	*d.*
Lent	62	18	09
Paid	37	19	06
Reſts	24	19	03
Proof	62	18	09

	li.	*s.*	*d.*
Borrowed	100	00	00
Received	36	13	04
Due	63	06	08
Proof	100	00	60

Other Examples in Weight and Meaſure.

1 Exa. in Troy weight

Bought	*li.*	*ou.*	*pw*	*gr.*
of Silver	07	11	13	19
Sold	05	07	03	05
unſold	42	04	10	14
Proof	07	11	13	19

2 Example in Avoirdupois great weight

	C.	*q.*	*li.*	*ou*
Bought	37	03	22	11
Sold	13	01	23	06
Reſts	24	01	27	05
Proof	37	03	22	11

3 Example in Avoirdupois little weight

	li.	*ou.*	*dr*
Bought	84	12	13
Sold	26	08	11
Reſt	58	04	02
Proof	84	12	13

4 Example in Time

	days	*ho.*	*m.*
From	364	23	50
Take	76	09	22
Reſts	288	14	28
Proof	364	23	50

Que-

Queſtions performed by Addition and Subtraction.

Queſtion 1 What nmber is that which added to 376 ſhall make 1000? Subtract 376 from 1000, the remainder is 624, the number ſought.

Queſtion 2. What number of pounds, ſhillings and pence muſt be added to 36 *l.* 17 *s.* 3 *d.* to make that ſum up 100 *li.* ſubtract 36 *li.* 17 *s.* 3 *d.* from 100 *li.* the remainer is 63 *li.* 2 *s.* 9 *d.* which added to 36 *li.* 17 *s.* 3 *d.* makes 100 *li.*

Queſt. 3. In the year of our Lord 1440, the famous art or myſtery of Printing was invented, I would know how long it is ſince that time to this yeer of our Lord 1655. From 1655, ſubtract 1440, the remainer is 215, and ſo many years are expired ſince printing was invented.

Queſtion 4 An Armie conſiſting of 13721 horſe, and 26850 foot, in an engagement there were ſlain 3760 horſ, & 7523 foot, the queſtion is how many were ſlain in all, & how many horſe and how many foot eſcaped. From the 1372 horſ which went ont, ſubtract the 3760 that were ſlain, there remains 9961, and ſo many horſe eſcaped, Alſo from the 26850 foot which went out, ſubtract the 7523 which were ſlain, and there remains 19327, the number of foot which

which eſcaped, and by adding the 3760 horſe which were ſlain, to the 7523 foot that were ſlain, their Totall is 11283, and ſo many were ſlain in all.

Multi-

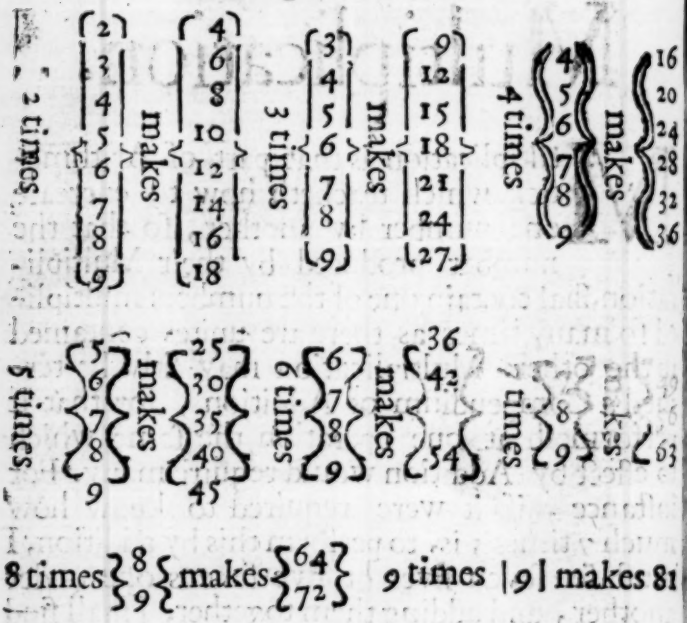
Multiplication.

Multiplication is that part of Arithmetick which teacheth how to encreaſe one number by another, ſo that the number produced by their Multiplication, ſhal contain one of the numbers multiplied ſo many times as there are unites contained in the other. Multiplication may fitly be termed a Compendium of Addition, for that it performeth at one operation the ſame which to effect by Addition would require many. For inſtance, if it were required to know how much 7 times 5 is, to perform this by addition, I muſt ſet ſeven fives or five ſevens one under another, and adding them together, I ſhall find that either of their Totalls ſhall contain 35, but this by multiplication is performed with far more brevity, as by examples hereafter ſhall appear

Before you enter upon the practice of Multiplication, it is neceſſary to remember the product produced by the multiplication of any one of the nine digits by any other of the ſame; as readily to know, that 4 times 5 is 20, 6 times 7 is 42, 2 times 9 is 18, 7 times 9 is 63. 8 times 9 is 27, &c. Which this Table following will

plainly declare, and must be perfectly learned by heart before you attempt to multiply great numbers.

Multiplication Table.



The use of the Table of Multiplication, and the manner how it is to be read.

This Table sheweth what the Summe of any two digits multiplied one by another doth amount unto, and is thus to be read, 2 times 2 makes 4, 2 times 3 makes 6, 2 times 4 makes 8. Also 6 times 4 makes 24, 7 times 8 makes 56, 8 times 8 makes (or is) 64, 9 times 9 is 81, &c. w

In Multiplication there are three terms commonly used, that is to say,

The

The *Multiplicand*,
The *Multiplier*, and
The *Product*

The *Multiplicand* is the number to be multiplied.

The *Muliplier* is the number by which the Multiplicaud is multiplied, and

The *Product* is the number which is produced by the multiplication of the Multiplicand and the Multiplier together.

Thus, if it were required, to multiply 8 by 7, here 8 is the *Multiplicand*, 7 the *Multiplyer*, and 56 is the *Product*, for 8 times 7, or 7 times 8, is 56.

In Multiplication it mattereth not which of the two numbers given is made the Multiplicand or which the Multiplyer for the product produced by either will be the ſame, but the uſuall way is to make the greater number the Multiplicand, and the leſſer number the Multiplyer.

THE RULE.

The numbers to be multiplied muſt be ſet one under another, viz. *the Multiplicand (or greater number) above, and the Multiplier, (or leſſer number) below, the laſt figure of the Multiplier under the laſt figure of the Multiplicand, then draw a line under them, and (having learned the preceding Table perfectly)*

fectly by heart) multiplie every digit of the Multiplier into every digit of the Multiplicand, ſetting the ſeverall product under the line, then having finiſhed your Multiplication, draw a line and add all the products together, and the Sum of thoſe products is the generall product of the whole multiplication, as by the following examples will appear.

Example 1. Let it be required to muliply 736 by 7. Firſt I write down 736 the Multiplicand, and under it 7, the Multiplye and under them I draw a line, then I multiply 7 into every digit of the Multiplicand, ſaying 7 times 6 is 42, place 2 under the line under 7, and for the four tens keepe 4 in mind, then ſay again, 7 times 3 is 21, and 4 which I kept in mind is 25, place 5 under the line, and keep the two tens in mind, then ſay again 7 times 7 is 49, and 2 which I kept in mind is 51, place 1 under the line, the 5 tens, (becauſe there is no more figures to be multiplied) I ſet down under the line alſo, ſo is the worke ended, and the product of this multiplication is 5152.

736	Multiplicand
7	Multiplier
5152	Product

Example 2. Let it be required to multiply 7417 by 5, place the numbers one under another, and draw a line under them as in the margine, then begin your multiplication, ſaying 5 times 7 is 35, place 5 under the line, and keep the three tens in mind, then ſay again, 5 times 1 is

is 5, and 3 which I kept in minde is 8, place 8 under the line, and (becauſe it is leſſe then 10 I keep nothing in mind) then ſay again, 5 times 4 is 20, place a cypher under the line, and keep the two tens in mind; laſtly, ſay 5 times 3 is 15, and 2 which I kept in mind is 17, which being the laſt figure I place under the line, and ſo is my Multiplication ended, and the product is 17085

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3417
   5
17085
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¶ You may be ſatisfied of the truth of this worke if you will take the pains to ſet down the Multiplicand 3417, five times one under another, and adde them together as ſo many ſeverall ſums ſo ſhall you find the Totall of that addition, to be 17085 exactly the ſame with the product of this Multiplication.

Example 3. In the two foregoing examples, the multiplyer conſiſted but of one digit, we are now to ſhew how multiplication is performed when the Multiplier conſiſts of more then one figure, therefore in this example, let it be required to multiplie 5704 by 37, place your numbers and draw a line under them as you ſee in the margine, then begin your Multiplication in this manner, ſaying, 7 times 4 is 28, ſet 8 under

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 5704  Multiplicand
   37  Multiplier
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 39928
17112
-------
211048  Product
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der the line, and keepe the two tens in mind, then ſay 7 times nothing is nothing, but the two tens in mind is 2, ſet 2 under the line, then ſay 7 times 7 is 49, ſet 9 under the line, and keep 4 in mind, then laſtly, ſay 7 times 5 is 35, and 4 in mind is 39, which being the laſt number to be multiplied I ſet down under the line, ſo is the multiplication of one of the digits (namely 7) finiſhed.

Then begin to multiply the ſecond digit, ſaying 3 times 4 is 12, place 2 in the ſecond line one place towards the left hand, and keep 1 in mind, then ſay 3 times nothing is nothing, but 1 in mind is 1, ſet down 1 by the 2 in the ſecond line, thirdly, ſay 3 times 7 is 21, place 1 in the ſecond line, and keep the two tens in mind; Laſtly, ſay 3 times 5 is 15, and 2 in mind is 17, which 17, (becauſe there is no more figures to be multiplied) I place in the ſecond line alſo.

Having thus done I draw a line under them, and adde theſe two lines together, as in common Addition of numbers of one denomination, ſaying 8 is 8, place 8 under the line, then ſay 2 and 2 is 4, place 4 under the line, then ſay 1 and 9 is 10, place a cypher under the line, and carry 1 to the next place ſaying 1 and 1 is 2 and 9 is 11, place 1 under the line and carry 1 to the next row ſaying 1 and 7 is 8, and 3 is 11, place 1 under the line, and carry 1 to the next place, ſaying, 1 which I carry and 1 is 2 place 2 under the line and ſo is your multiplication ended, and the product is 211048.

Example 4. Let it be required to multiply 57325 by 4032, place the multiplicand and multiplier one under another, and draw a line as before, then proceed to the multiplication as formly, saying, first, 2 times 5 is 10, set down a cypher and keep 1 in mind: then 2 times 2 is 4 and 1 in mind is 5, place 5 under the line then 2 times 3 is 6, set 6 under the line: then 2 times 7 is 14, set down 4 and keep 1 in mind, then 2 times 5 is 10 and 1 in mind is 11, which 11 (being the last) I set down.

```
   57325 Multiplicand
    4032 Multiplyer
  -------
  114650
 171975
229300
-------
231134400 Product
```

The multiplication of one of the digits being finished proceed to the multiplication of the next, saying, 3 times 5 is 15, set down 5 in the second line a place more towards the left hand, and keep 1, then 3 times 2 is 6 and 1 kept is 7 set down 7, then 3 times 3 is 9, set down 9, then 3 times 7 is 21, set down 1 and keep 2 in mind, then 3 times 5 is 15 and 2 in mind is 17, which being the last set down also.

Two of the figures of the multiplier being finished proceed to the third, which (in this example) being a cypher, you may wholly neglect, and proceed to the multiplication of the fourth figure, only remember to remove the product of the fourth figure one place more to the

the left hand, as in the example you may ſee, for the cypher, though it be not written down, yet it muſt keepe its place, and the figures following muſt be removed a place farther.

Then for the Multiplication of the fourth and laſt digit, ſay 4 times 5 is 20, ſet down a cypher (under 9) and keep 2 in mind, then 4 times 2 is 8 and 2 in mind is 10, ſet down a cipher and keep 1 in mind, then 4 times 3 is 12 and 1 is 13, ſet dow 3 and keep 1, then 4 time; 7 is 28 and 1 kept is 29, ſet down 9 and keep 2, then 4 times 5 is 20, and 2 kept is 22, which 22 (becauſe the multiplication is ended) ſet down alſo.

Having thus multiplied all the digits ſeverally, draw a line under their products, and adde them all together as in the former example, ſo ſhall you find their generall product to be 2311344c0.

Other Examples for Practice.

73260	50762
45003	4567
219780	355334
36630000	304572
293040	253810
3296919780	203048
	231830054

Com-

Compendiums in Multiplication.

1 If the Multiplier conſiſt of cyphers in the laſt place or places, you may omit the multiplication of them, and place the former figures of the Multiplier under the Multiplicand, thus if it were required to multiply 3257 by 2600, place the numbers as you ſee in the margent: then multiplying 3257 by 26, the Product will be 84682, to which if you add two cyphers, (becauſe there were two ciphers in the Multiplier) it will be 8468200, which is the true product of the multiplication.

```
 3257
 2600
-----
19542
6514
-----
84682
```

2 If it be required to multiply any number by 10, 100, 1000, 10000, &c. You have no more to do but to add ſo many cyphers to the multiplicand as there are cyphers in the multiplier, thus if you were to multiply 365 by 10, the product will be 3650, or by 100, it would be 36500, or by 1000, it would be 365000, or by 10000, it would be 3650000, &c.

3 If any number given were to be multiplied by 5, you may abreviate your worke thus, adde a cypher to the Multiplicand, then take half that number, and it ſhall be the product required, thus if it were required to multiply 8627 by 5, adde a cypher to the multiplicand, then it is

86270

86270 the halfe whereof is 43135 which is the product required.

The Proof of Multiplication.

The moſt certain proof of Multiplication is by Diviſion, but becauſe Diviſion is not yet known, I will here ſhew a neer way by which Multiplication may be proved. Which is thus,

THE RULE.

Firſt, take a Croſſe as in the Margine, then, any ſums being multiplied you may proove the truth of your work in this manner, (1) *Caſt away all the nines which you can find in the multiplicand, what remaineth ſet on the right ſide of the Croſs.* (2) *Caſt away alſo the nines in the Multiplyer, and what remains ſet on the left ſide of the Croſs.* (3) *Multiply the figure on the right ſide of the Croſs by that on the left ſide of the Croſſe, and out of that product caſt away the nines, ſetting the figure remaining over the Croſſe, then* (4) *Caſt away all the nines in the product, and if the figure remaining be the ſame with that which ſtandeth over the croſſe then is your multiplication truly performed, otherwiſe not.*

Example 1 Let it be required to proove the Sum in the margine,

4324	
23	
12972	
8648	
99452	

1. Caſt away all the nines in the Multiplicand, ſaying 4 and 3 is 7, and 2 is 9, which being rejected there re-

remains 4, which I ſet on the right ſide of the croſſe, then

2 Caſt away all the nines in the Multiplier, ſaying 2 and 3 is 5, which (being leſſe then 9) I, ſet on the left ſide of the croſſe, then

3 Multiply 4 by 5, ſaying 4 times 5 is 20, from which caſt all the nines, and there remains 2, place 2 over the croſſe, and

4 Caſt away all the nines in the Product, ſaying, 2 and 5 is 7, and 4 is 11, caſt away 9 and there remains 2, which exactly agrees with the figure over the croſſe, and demonſtrates that the multiplication is truly performed.

Queſtions performed by Multiplication only.

Queſtion 1. If a piece of land be 236 perches long, and 182 perches broad, how many ſquare perches are contained therein? Multiply 236 the length, by 182 the breadth, the product is 42952 and ſo many ſquare perches are contained in ſuch a ſquare piece of land.

Queſtion 2. In a yeare there are 365 dayes naturall, and in every day 24 houres, how many houres be there in a yeare? Multiply 365 the number of dayes, by 24 the number of houres, the product is 8760, and ſo many houres be there in a yeare.

Queſti-

Question 3. From *London* to *Coventry* it is accounted 76 miles, how many yards therefore is it from *London* to *Coventry*? Multiply 1760 (which are the number of yards contained in one mile) by 76, the product is 133760, and so many yards are between *London* and *Coventry*.

Di-

Division.

DIviſion is the juſt contrary to Multiplication, for that turnes ſmall denominations to greater, as Multiplication turns greater to ſmaller. Or (in whole Numbers, of which only we yet ſpeak) *Diviſion* is the asking *how many times one Sum is contained in another?* and the number which anſwereth to that queſtion is called the *Quotient*.

And the number containing, which is to be divided, is called the *Dividend*.

And the number contained, or by which the Dividend is to be divided, is called the *Diviſor*.

And as often as the Dividend contains the Diviſor, ſo often doth the quotient containe unity.

The wayes of performiug Diviſion are divers; I will begin with that which is moſt uſed and taught, which is as followeth.

THE RULE.

Place the Diviſor under the Dividend ſo that the figures next to the left hand ſtand directly one under the other, if the rſt of the diviſor be not greater; or

if

if all the Diviſor be greater then that above it, then the ſaid diviſor muſt be devolved one place further toward the right hand; having ſo placed them, try how many times the lower figures are contained in the upper figures, and write that figure which anſwereth that queſtion within a croocked line in the margine of the work, which is called the Quotient, and by it multiply the firſt figure of the Diviſor, and take the product out of the figures directly over it, beginning the Subtraction toward the left hand; then cancell that figure of the diviſor, and alſo that of the dividend which hath been already uſed, with a light daſh of a pen, and write the remaine (when the product of the firſt figure multiplied by the quotient is ſubtracted as before) juſt over the figure uſed and cancelled; then proceed to doe the like with the ſecond, third, and fourth figure of the diviſor if there be ſo many; till having cancelled it all, and ſet the remaine orderly above the dividend, you have finiſhed one work.

Now if the dividend have ſtill ſome figures untouched towards the right hand, then remove the diviſor ſtill toward the right hand, but one place at a time, and then againe aske or try how many times the lower may be had in the upper, and write the anſwer in the quotient whether it be 1 or more, (onely it cannot be above 9) or nothing, then put 0 in the quotient, and multiply the diviſor by this new figure, and ſubtract the product, ſetting the remainer orderly above, as before, this worke muſt be repeated by removing the diviſor ſtill one place towards the right hand, untill Unity in the diviſor ſtand under Unity in the dividend, and then the worke is doue.

Ex-

Example 1.

Let it be required to divide 4096 by 3
Place them thus

```
4096(1
 3
```

Aske how many times 3 in 4 the quotient is 1 which is put within a croocked line by it ſelf.

Then in your mind multiply the Diviſor 3 by the quotient 1. And having ſaid theſe words *Once 3 is* 3, preſently cancell the 3. And having added theſe words, *Out of* 4, cancell the 4. And after theſe words, *and there remains* 1, write 1 juſt over the 4 as you ſee here done.

```
 1
4096(1
 3
```

Then remove the diviſor one place towards the right hand, ſaying, *how many times* 3 in 10, the anſwer is 3, which write in the quotient; and in your mind, multiplie the Diviſor 3 by the quotient 3, the product is 9, wherefore ſay three times three is nine out of ten, and there remains one, then (having cancelled the 10 and the 3 write over them 1.

```
 1 1
4096(13
 3 3
```

Againe remove the Diviſor 3 one place more, asking *how many times* 3 *in* 19? the anſwer being 6, write 6 in the quotient, and ſay 6 times 3 is 18 out of 19, and

```
 1 1 1
4096(136
 3 3 3
```

there

there remains 1 wherefore having cancelled the 2, and the 19 write 1 over 3 and remove the Diviſor once more, and aske *how many times 3 in* 16? anſwer is 5, which write in the quotient, then in mind ſay 5 times 3 is 15 out of 16, and there remains 1, and cancelling the 16 and the 3, write over 3, 1

x x x 1
4096(1365
3 3 3 3

Now becauſe the Diviſor 3 is advanced ſo farre till it is come to ſtand under 6 in the Dividend, which 6 is the place of Unity there, the ſaid Diviſor cannot be removed any more, and therefore the diviſion is ended. And the quotient being 1365, ſhewes that the Diviſor 3 is contained in the Dividend 4096, 1365, times; and 1 remaining, which 1 being leſſe then the Diviſor 3, doth not containe it once, but one third part of once, which after the Reader hath skill in broken numbers, muſt be joined to the quotient thus $1365\frac{1}{3}$. The beſt proof of this Diviſion is by multiplying the quotient into the Diviſor, and to the product adde the remaine, then if the work be well done, the ſum ſhall be equall to the Dividend.

So 1365 multiplied by 3 produceth 4095, to which adding the remain 1, the ſum 4096 is equall to the Dividend.

Here we divided only by one figure 3, becauſe the firſt Example being eaſie and clear, ſhould be a faire Introduction to the ſecond.

Note that if the Diviſor had been greater then

4, as

4, as 5, the worke muſt have begun thus 4096(

So the quotient would have been $819\frac{1}{5}$ which is one place leſſe.

Example 2.

Let it be required to divide 1310720 by 4096.

Place them thus

1 3 1 0 7 2 0
4 0 9 6

Now the queſtion to be asked is, how many times 4096 in 13107? to find an anſwer to this queſtion, the Reader which hath but an indifferent faculty of judging, may do it (for the moſt part) by conſidering the firſt figure in the diviſor, as here 4, for preſently he knowes that 4 times 4 is 16, which cannot be had in 1, therefore the firſt figure in the quotient muſt be leſſe then 4.

Againe, it cannot be much leſſe, becauſe the ſecond place in the Diviſor is 0.

He may therefore venture on 3, And having put 3 in the quotient, ſay 3 times 4 is 12, which ſubtract out of 13 over it thus, ſay 2 out of 3, and there remains 1, and 1 out of 1 and there remaines 0, cancelling the 4 and the 13, and ſet the remaine 1 over the 4, as you ſee.

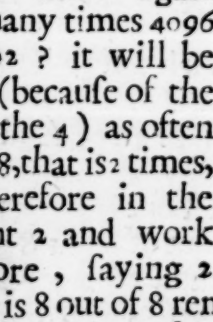
1
x 8 3 9
x 3 x 0 7 2 0(3
4 0 9 6

Then goe on ſaying 3 times 0 is 0, out of 11,

and remains ſtill 11, againe 3 times 9 is 27, take 7 out of 10 there remains 3, to be ſet over the 0 over 9, and 2 with 1 borrowed (to make the 0 10, from the which the 7 was taken) is 3, and 3 out of 11, remains 8, which write over the place of 0 in the Diviſor, cancelling the 9 in it, and alſo thoſe figures of the Dividend 110, out of which you have taken any thing; then laſtly, ſay 3 times 6 is 18, take 8 out of 7 I cannot, therefore (borrowing 10) ſay 8 out of 17 remains 9 which write over the 7, then in the next place, the 10 borrowed is 1, and the 10 in the 18 is 1. Say therefore 1 and 1 is 2 out of 3, and the remain is 1 which write over the 3, having ſtill cancelled the figures which you have uſed orderly as you goe.

Now the whole Diviſor being cancelled it muſt be removed on one place further and placed as here.

Now aske again how many times 4096 in 8192? it will be found (becauſe of the 0 after the 4) as often as 4 in 8, that is 2 times, put therefore in the quotient 2 and work as before, ſaying 2



times 4 is 8 out of 8 remains 0, then 2 times 0 is 0 out of 1 remains 1, then 2 times 9 is 18, take 8 out of 9 remains 1 (which put over the 9) and 1 out of 1 in the next place remains 0, then laſtly, 2

times

times 6 is 12 that is 2 out of 2 there remains 0, and 1 out of 1 there alſo remains 0; cancel and put the remainer over as formerly.

Now againe the Diviſor being all cancelled ſhould be removed; and aske how many times 4096 in 0000. the anſwer is 0 which being put in the quotient, the work is all done.

And the quotient 320 ſhewes that the Diviſor 4096 is contained in the Dividend 1310720, three hundred and twenty times.

And whether the Diviſor have 2, 3, 5, 7, or more places, the working is ſtill like this not differing from it at all.

Except for brevity in ſome caſes. where the Diviſor toward the right hand hath one Cypher or more; for thoſe Cyphers may be placed orderly under the Dividend at firſt and remain there till the work be done with the reſt of the Diviſor which muſt needs ſhorten the Diviſion.

As if 2587645 were to be divided by 15000, place them thus 2587645 (
15 000

And ſay how many times 15 in 25? anſwer is 1 which write in the quotient, and multiply in minde the diviſor by the quotient, ſaying once one is one, out of 2 there remains 1, then cancel the 2 and the 1 under

0 0
3 x
x 8 3 7
x 5 8 7 6 4 5 (1 7 2
x 5 5 5 0 0 0
x x

der it, and write the remaining 1 over it, as here is done, then ſay once 5 is 5 out of 5 and there remains 0, therefore cancell the two 5, and over the uppermoſt write 0.

Now remove the Diviſor one place, and aske how many times 15 in 108? anſwer is 7, which write in the quotient, and multiply, ſaying 7 times 1 is 7, out of 10 remains 3, which write over the 0, then ſay 7 times 5 is 35, take 5 out of 8 remains 3, which write over 8, and 3 out of 3 remains 0.

Now againe remove the Diviſor, and aske how many times 15 in 37? anſwer is 2, which write in the quotient, and ſay 2 times 15 is 30 out of 37 remaines 7, and the Diviſion is ended, the remaine being 7645.

Proof of this.

Multiply the quotient	172
by the Diviſor	15
	860
	172
The Product is	2580
Before which put the three Cyphers, And then it is	2580000
To which adde the remaine	7645
The Totall is	2587645

Which is equall to the Dividend, and therefore the worke is right.

So

So if one would divide any ſum by 10, 100, 1000, 10000, &c. he need but cut off the firſt, two firſt, three firſt, or four firſt figures towards the right hand, the other figures ſhall be the quotient, and thoſe cut off, the remaine.

As if 1587645 be divided by 1000 the quotient is 1587, and the remaine 645.

If one would know how many pounds Sterling are in 95670 ſhillings; having placed them thus,

that is, 2 under 9, and 0 under 0, then divide by 2 which is very eaſie. So the quotient 4783, ſhewes that in the	*x x* 1 9 5 6 7 0 (4783 *z z z z* 0

number of ſhillings given, is contained 4783 pounds, and 10 ſhillings remaining.

The reaſon why the Diviſor was 2, is becauſe there are 20 ſhillings in one pound, and therefore any number of ſhillings is, turned into pounds, by dividing by 20, that is by 2 putting the cypher under unity, onely to fill a place at laſt.

In this way of Diviſion, and in all other, if the remaine at laſt be greater then the Diviſor, the quotient is not juſt, but too little, which may be remedied (without beginning the work againe) by dividing the remainer onely by the ſame diviſor; for thereof will ariſe a new quotient, which added to the former quotient, the ſumme will be the juſt quotient.

So if 7290 be divided by 27, the numbers being placed thus

Now becauſe 27 can be had in 72 but twice, put 2 in the quotient ſaying, 2 times 27 is 54 out of 72, and there remains 18 which write over 72 cancelling as before is ſhewed; then removing the Diviſor, ſay how many times 27 in 189, anſwer is 7, but if one ſhould miſtake, and write 5 in the quotient, and ſay 5 times 27 is 135, out of 189 remains 54, and write it over as before; and remove the Diviſor and ſay how many times 27 in 540? anſwer is 20, but ſhould not be above 9 ſay therefore 9 times 27 is 243 out of 540, and the remain is 297, wich being the laſt remain, and greater then the Diviſor, ſhews the quotient 259 is too little.

```
  2
  59
 1847
 7290(259
 2777
  22
```

Wherefore divide the laſt remain 297. By the Diviſor 27 ſaying, twenty ſeven in 29 once, and write 1 in the new quotient; and ſay once 27 is 27 out of 29 remains 2 which write over 9 and remove the Diviſor, and ſay 27 in 27 juſtly once, ſo write 1 in the quotient, ſo the quotient is 11 which added to the former quotient 259 gives 270 which is the true and whole quotient.

```
  2
 297(11
 277
  2
```

Another way of Diviſion.

Although (as I have ſaid) the former way is more

more used, yet this may seem plainer and more natural to some, I will therefore give one example of it.

Example.

Let it be required to divide 6477734 by 334 where the first figure in the quotient is easily seen 1, subtract once 334 out of 647 and write the remain under a line, then see how many times 334 in 3137 answer 9, by which multiply the divisor 334 in another paper, the product is 3006 which subtract out of the remain, then the new remaine is 131734.

```
6477734(1949
334
3137734        Rem
3006           Subt
0131734        Rem
01002          Subt
0031534        Rem
003006         Subt
0001474        Rem
0001336        Subt
....138        Rem
```

Again how many times 334 in 1317 answer is 4, for the third figure in the quotient, by which multiply the Divisor, the product is 1002 which take out of the later remaine as in the margine, then will remain 31534

Now try how many times 334 in 3153? answer is 9, for the fourth figure in the quotient, by which multiply the divisor (in a by paper) the product is 3006 (as might have been seen above

in the ſecond ſubtraction) which ſubtracted out of the later remaine, there remains now 1474.

Laſtly, aske how many times 334 in 1474? anſwer is 4 for the laſt figure in the quotient, by which multiplying the diviſor 334, the product is 1336, which ſubtracted from 1474 remaines; finally, 138, which being leſſe then the diviſor, ſhewes the diviſion is done.

Proof of this.

	334....
The ſeverall ſubtractions	3006...
and the final remaine added	.1002..
together.	..3006.
	...1336
	138
The Totall equall to the dividend	6.477734

If the former (as I have ſaid more uſual) way ſeem difficult to beginners, becauſe the products of the diviſor into the ſeveral figures in the quotient are not ſet down but mentally made; and alſo becauſe the ſubtraction of them begins towards the left hand; and laſtly, becauſe the remaine is ſtill ſet above: yet this later way which agrees altogether with plain Subtraction before taught, I hope is ſo plain, that any diligent reader may acquire it, without a Tutor.

An-

Another way of Diviſion.

There is another kind of diviſion which is very much uſed, and is in moſt requeſt with thoſe who have moſt occaſion to divide great numbers, the manner of working is not much unlike the preceding way before taught, one or two examples will make it plain.

Example 1. Let it be required to divide 162483 by 1321, ſet down your numbers as you ſee them placed in the margine, *viz.* Firſt, ſet down 162483 the dividend, then on the left hand thereof ſet the diviſor 1321 with a crooked line between them, then on the right hand thereof make another crooked line which muſt ſerve to ſet the figures of the quotient in, ſo are your numbers placed in due order, then draw a line under the dividend, and make a prick under the figure 4, becauſe ſo far the figures of the diviſor would extend were they placed underneath the dividend, according as in the other examples, this prick ſerves only to ſhew how far you have proceeded in your work, and muſt at every diviſion be removed a place further, till at length you come to the laſt figure of the dividend: your numbers being thus placed with a line under them you are ready for the work, which muſt be performed according to the directions of the following rule.

1321)162483(

———

The

THE RULE.

Demand how often the divisor may be had in the dividend, and place that number in the quotient, then multiply the divisor by the quotient and place the product under the line, then subtract this product from the dividend, and set the remainer under the product, then make a prick under the next figure of the dividend, and bring that figure down to the remainer, and then proceed as before.

Example, Your numbers being placed as is before directed, you may begin your work in this manner, first, say how many times 1321, can I have in 1624? say once, place 1 in the quotient, by which 1 multiply the divisor 1321, beginning at the left hand saying, once one is 1, place 1 under the line then once 2 is 2, set 2 under the line, then once 3 is 3, place 3 under the line, lastly, once 1 is 1, place 1 under the line, then subtract this 1321 from 1624, and there will remain 303, to this 303 bring down the next figure in the dividend, namely 8, so will that number be 3038, under which draw a line, and repeat the same work again, saying, how many times 1321 can I have in 3038, which may

```
1321)162483(123
       ...
     1321
      3038
     2642
      3963
      3963
      0000
```

may be hand two times, place 2 in the quotient, by which 2 multiply the divisor 1321, saying 2 times 1 is 2, place 2 under the line, then 2 times 2 is 4, place 4 under the line, then 2 times 3 is 6, place 6 under the line, lastly, 2 times 1 is 2 place 2 under the line, and subtract this 2642 from 3038, and there will remain 396, to this 396 bring down the next figure of the dividend, which is 3, so is this number made 3963 under which draw a line, and repeat the work once again, saying, how many times 1321 can I have in 3963? which may be had 3 times, by which 3 multiply the divisor 1321, saying 3 times 1 is 3, then 3 times 2 is 6, then 3 times 3 is 9, and lastly, 3 times 1 is 3, which place under the line, and subtract it from the line above which in this example is the same number, therefore there remains nothing, and the work is ended, but if any remainer had been, that should have been set under the line as by the examples following will appear.

Other Examples for Practice.

```
5624) 793058 (141
      ------
      5624
      23065
      ------
      22496
        5698
      ------
        5624
          74 remains
```

In this Example where 793058, is divided by 5624, you may perceive that the quotient is 141, and 74 remaining, so that the real quotient is 141 $\frac{74}{5624}$.

The

The Proof of this Division.

This kind of division is proved by Addition, for *If you adde the severall products arising from the multiplication of the severall quotients into the divisor, and also adde thereunto the remainder (if any be) the totall of this addition shall be equal to the dividend, if there be no error in the worke.*

So in the example following, if you adde 4325 the first product, and 30275 the second product, and 2796 the remainder, together, in the same order as they now stand in the example, you shall find the Totall of this Addition to be 76321 equall to the dividend, which demonstrates the work to be true.

```
                4325) 76321 (17
                      ------
1 Product             4325
                      33071
                      ------
2 Product             30275
                       2796 remain.
                      ------
                      76321 proofe
```

Another way of Division.

There is a fourth way of division used by some, not inferiour to any of the preceding, for that it is no charging of the memory, and it is also proved by Addition.

The manner of placing the figures is the same with

with the third kind of diviſion laſt taught; And for the performance of the work, this is

THE RULE.

Firſt write down the dividend, and on the left hand thereof the diviſor, with a crooked line betwixt them, and on the right hand of the dividend make another crooked line wherein to place the figures of the quotient, then draw a line under the dividend, and alſo mak a prick under that figure of the dividsnd under which the laſt figure of the diviſor would fall were it to be placed as in the firſt kind of diviſion, this done, demand how often the diviſor may be found in thoſe figures of the dividend, and place that digit in the quotient, then by this digit multiply the diviſor, and ſet the product of this Multiplication directly under the dividend, beginning at the place where you made the prick, then ſubtract this product from the figures of the dividend, and place the remainder over the dividend, cancelling the figures of the divideud as you proceed, ſo is the firſt figure of the quotient finiſhed, then make a prick under the next figure of the dividend, and demand how often the diviſor may be found in the laſt remainder, and the other figure being added thereto, which place in the quotient, and proceed in all reſpects as before, till you have pointed all the figures of the dividend.

Example, Let it be required to divide 763258 by 2345, place your numbers as you ſee in the margent, and becauſe there are 4 figures in the divi-

2345) 7 6 3 2 5 8 (

diviſor therefore make a prick under the fourth figure of the dividend which is 2, and draw a line, then begin your diviſion in this manner, ſaying,

Firſt, how many times 2345 can I have in 7632? (or how many times 2 can I have in 7) ſay 3 times, place 3 in the quotient, by which 3 multiply the diviſor, ſaying 3 times 5 is 15, place 5 under the prick, then 3 times 4 is 12 and 1 is 13, place 3 under the line, then 3 times 3 is 9, and 1 is 10, place a cypher under the line, then 3 times 2 is 6 and 1 is 7, place 7 under the line, then ſubtract 7035 from 7632, ſaying 5 from 12 and there remains 7, place 7 over 2 (cancelling the 5 and the 2) and bear one in mind, then 1 and 3 is 4, out of 13 there remains 9, place 9 over 3, and cancell 3 and 3, then 1 which I carried from 6 and there remains 5, place 5 over 6, and cancell 0 and 6, laſtly, 7 from 7 there remains 0, which you need not ſet down, but cancell the two ſevens, then will the work ſtand as above, and the remainder will be 597.

```
      597
2345)7632(3
     7035
```

Secondly, make a prick under the next figure of the dividend, namely 5, and ſay how many times 2345 can I have in 5975? anſwer two times, place 2 in the quotient, by which multiply the diviſor, ſaying 2 times 5 is 10, place 0 under 5 and carry 1, then 2 times 4 is 8 and 1 is 9, place

place 9 under 7, then 2 times 3 is 6, place 6 under 9, lastly, 2 times 2 is 4, place 4 under 5, so is the product of this multiplication 4690, which you must subtract from 5975, saying 0 from 5 and there remains 5, place 5 over 5, and cancell 0 and 5, then 9 out of 17 there remains 8, place 8 over 7 and cancell 9 and 7, then 1 carryed and 6 is 7, from 9 there remains 2, place 2 over 9 and cancel 6 and 9, lastly, 4 from 5 rests 1, place 1 over 5, and cancel 4 and 5, so have you finished your second figure, and your work will stand thus, and your remainder will be 128.

```
        128
        5975
2345) 763258 (32
      ------
      70350
        469
```

Thirdly, make a prick under the next figure of your dividend (namely under 8) and aske how many times 2345 can I have in 12858? (or how many times 2 can I have in 12) say 5 times, place 5 in the quotient, by which multiply the, divisor, saying 5 time 5 is 25, place 5 under 8 and carry 2, then 5 times 4 is 20, and 2 is 22, place 2 under 0, and carry 2, then 5 times 3 is 15 and 2 is 17, place 7 under 9, and carry 1, then 5 times 2 is 10, and 1 is 11, place 11 under 4 and 6, so is the product of this multiplication 11725 to be subtracted from 12858, saying 5 from 8 rests 3, place 3 over 8, & cancel 5 & 8, then 2 from 5 rests 3, place 3 over 5 and cancell 2 and 5, then 7 from 8 rests 1, place 1 over 8 and cancell 7 and 8, then 1 from 2 rests 1, place 1 over 2, and

2, and cancell 1 and 2, lastly, 1 from 1 rests nothing, so is your work ended, which you shall find to stand as in the margent, the remainder being 1133

```
        1 1
       1 2 8 3
       5 9 7 5 3
2325) 7 6 3 2 5 8 (325
      ---------
      7 0 3 5 0 5
        4 6 9 2
        1 1 7
```

The Prof of this Division.

This kind of division is also proved by Addition, for, *if you draw a line under the work, and adde all the figures between the two lines together, (in order as they there stand) taking in the remainder (if any be) the Totall of this addition will be equal to the Dividend, if the worke be true.*

Other Examples for Practice proved.

```
          4
        2 2 1 7 3
542) 7 6 3 5 3 (140
     -----------
     5 4 2 8 0
     2 1 6
     -----------
     7 5 8 8 0
to which adde   4 7 3 the remaine
     -----------
the smm is   7 6 3 5 3 equal to the dividend
                                          5678
```

6
x766
74494
5678)x345678(413

x27x284
5673
x70

2345014
to which add 664 *the remainder*

the total is 2345678 *equal to the divid.*

Queſtions performed by Diviſion only.

Queſtion 1. If a ſquare piece of Land containd 42952 ſquare perches, and one of the ſides thereof be 236 perches long, how long muſt the other ſide be? Divide 42952 by 236, the quotient will be 182, and ſo many perches long muſt the other ſide be.

Queſtion 2. In a yeare there are 8760 houres, and in every naturall day there are 24 houres, I demand how many dayes be there in a yeare? Divide 8760 by 24 the Quotient will be 365, and ſo many daves be there in a yeare.

Queſtion 3. The diſtance from *London* to *Coventry* is 133760 yards, and in one mile there is

contained 1760 yards, now I would know how many miles it is from *London* to *Coventry*? Divide 133760 by 1760, the quotient will be 763, and so many miles is it from *London* to *Coventry*.

These Questions performed by Division only are the converse of those that were performed by Multiplication, which the rather make choise of that the reader might see how Multiplication and Divisiou prove each other.

There are one or two more kinds of division, something like these last, but I shall forbear exemplifying them; for much variety helps to make a Book rather great then fit.

¶ Here is to be noted that in the following Rules, where there is continual use of Division I sometimes use one kinde of Division, and sometimes another, for variety sake, but the practitioner may use which he is best skill'd in, for they all produce the same effect.

Re

Reduction.

IS twofold, first that which turnes greater denominations into ſmaller as pounds into ſhillings or pence, this is done by Multiplication as followeth.

Example 1.

Let it be asked how many pence are contained in 729 *li.* 11 *s.* 7 *d*?

First, a ſhil. is contained in a pound 20 times there multiply 729 by 20, or (which is the ſame, but ſhorter) by 2, and put 0 to the product, as in the margine, this ſhews that in 729 *l.* there are 14580 ſhillings.

To which adde 11 *s.* it makes 14591 ſhillings.

Again, becauſe one peny is contained in one ſhilling 12 times, multiply 14591 by 12 it produceth 175092, to

li.	
729	
2	*multiply*
14580	
11	*adde*
14591	
12	*multiply*
29182	
14591	
175092	
7	*adde*
175099	

which add the 7 pence, ſo the ſumme will be 175099, and ſo many pence are contained in 729 *li.* 11 *s.* 7 *d.*

Example 2.

Let it be asked how many pintes are contained in 4 Tun, 3 Hogſheads, and 27 Gallons?

Firſt, 1 Tun is equall to 4 Hogſheads, therefore 4 Tun is equal to 16 Hogſheads, to which adde the 3 Hogſheads, ſo there is 19 intire Hogſheads.

Againe, becauſe one Hogſhead containes 63 Gallons, multiply 19 by 63, it produceth 1197 Gallons, to which add 27 it gives 1224 Gallons.

Laſtly, becauſe every Gallon contains 8 pintes, multiply 1224 by 8, it produceth 9792, and ſo many pintes are contained in 4 Tuns, 3 Hogſheads and 27 Gallons.

63	
19	*multiply*
567	
63	
1197	
27	*adde*
1224	
8	*multiply*
9792	

After the ſame ſort might drie Meaſures be reduced, as quarters to buſhels, pecks, or gallons, and likewiſe all weights and outlandiſh Coins, of which the proportion of the greater to the leſſer is before known, or given.

Secondly, it is often requiſite to turne ſmaller denominations to greater: this is done by Diviſion, as followeth.

Ex-

Example 1.

Let it be asked how many pounds are contained in 80976 ſhillings?

Divide 80976 by 20 the quotient is 4048 *li.* and 16 *s.* remaining, which is the true anſwer.

```
   1 1
8 0 9 7 6 (4048
2 . 2 2 0
```

Example. 2.

Let it be asked how many pounds are in 109754 *d*?

Becauſe a pound contains a ſhilling 20 times; and a ſhilling containes a peny 12 times, therefore if 109754 be divided firſt by 12 the quotient 9146 ſhillings and 2 pence over, then 9146, be divided by 20, the quotient is 457 pounds and ſix ſhillings remaining: ſo that 109754 pence is equal to 457 *li.* 6 *s.* 2 *d.*

Or if 109754 had been at firſt divided by 12 times 20, that is by 240, (which is the number of pence contained in a pound) the quotient had been 457 pounds, and 74 pence remaining, which is all one with the former; for 74 pence is equal to 6 ſhillings 2 pence.

More inſtances ſhall not need herein, becauſe the thing of it ſelf is very cleare.

Progreſsion.

IS alſo of two ſorts, the firſt is of certain numbers in Arithmeticall Proportion from 1, that is, ſuch as differ equally, as 1, 2, 3, 4, 5, 6, where the common difference is 1, (as is eaſily ſeen) or 1, 3, 5, 7, 9, 11, where the common difference is 2, or any other, as 1, 8, 15, 22, 29, 36, where the common difference is 7, this is called *Arithmetical Progreſſion.*

2 Secondly, of certaine numbers in *Geometrical* proportion from 1, that is ſuch as increaſe by a common Multiplication as 1, 2, 4, 8, 16, 32, where the common multiplier is 2, that is the firſt by 2 produceth the ſecond, and the ſecond multiplied by 2 produceth the third, and ſo on.

Or as 1, 3, 9, 27, 81, 243, where the common Multiplier is 3, this is called *Geometrical Progreſſion.*

Both the common difference (in the firſt) and the common Multiplication (in the later) ſhall for ſhortneſſe hereafter be called the *common exceſſe.*

Firſt, now of the firſt ſort, or *Arithmetical Pro-*

Progreſſion the principal uſe of this is,

1 If the number of places, and common exceſſe be given, to find the laſt number.

2 When the number of places, and the laſt number is given, to find the aggregate, or total ſumme of all the numbers.

3 When the laſt number, and the totall ſumme is given, to find the number of places.

4 The Number of places, and totall ſumme being given, to find the laſt number.

5 The laſt number, and number of places giuen, to find the common exceſſe.

6 The laſt number, and common exceſſe being given; to find the number of places.

I will inſtance in no more, few of theſe ever hapning to be uſed.

For the firſt of theſe, let there be given the number of places 100
The common exceſſe 1
To find the laſt number, alſo 100

THE RULE.

Multiply the number of places leſſe by 1, *by the common exceſſe, and to the product adde the firſt number; the ſumme is equal to the laſt number.*

So here multiply 99 by 1 the product is 99, (for 1 neither multiplies nor divides) to this adde the firſt number 1 it gives 100 for the laſt number.

So here multiply 99 by 1, the product is 99 (for 1 neither multiplyes nor divides) to this adde the firſt number 1, it gives 100, for the laſt number.

Or let the numbers be 1, 7, 13, 19, 25, 31,

where the common exceſſe is 6, and the number of places alſo 6.

Now (if the number of places leſſe by 1 that is) 5 be multiplied by the common exceſſe which is 6, the product is 30, to which adding the firſt number which is 1, the laſt number 31, is thereby compoſed. This is ſo eaſie that it needs no proofe.

2 For the ſecond, which is, The laſt number, and the number of places given, to find the totall ſumme of all the numbers.

THE RULE.

Adde the firſt and laſt numbers together, and multiply the ſumme by half the number of places, the product is equal to the aggregate or ſumme of all the numbers added together.

So if to the firſt number 1 be added the laſt number 100, it gives 101 which multiplied by 50 (which is half the number of places) produceth 5050, which is equall to all the hundred numbers added together.

And hereby may that vulgar queſtion be anſwered, which is,

If a man take up 100 ſtones placed a yard one from another all in a right line, by one at once, and bring them back one by one to his firſt ſtanding, how many yards doth he goe backwards and forwards?

It is ſhewed before that he goes forward 5050 yards, and he muſt needs come back juſt as much; that is, in all 10100 yards which is 5 miles and 3 quarters, wanting 20 yards.

Or

Or ſecondly, ſuppoſe the numbers were 1,9,17, 25,33,41, Whereof the common exceſs is 8, the firſt and laſt added gives 42,which multiplied by 3, (half the number of places)the product is 126, which is the ſumme of them all.

3 For the third thing, that is, by the laſt number and the total, to find the number of places.

THE RULE.

Adde the firſt and laſt numbers, and by the ſumme of them divide the total, the quotient will be equal to half the nnmber of places.

$$\begin{array}{r|l} 126 & 3 \\ 42 & \end{array}$$

This is ſo plain it needs no cleering.

4 For the fourth, if the total, and number of places be given, to find the laſt number.

THE RULE.

Divide the total by half the number of places, the quotient is a number, from which if 1 be taken, the reſt is the laſt number.

As let the numbers be 1, 3, 5, 7, 9 11, 13, 15,or any other (in arithmetical proportion) whatſoever. The ſumme of theſe is to be 64. And the number of places is 8, the half of it 4. Now if 64 be divided by 4 the quotient is 16,from which if 1 be taken there remains 15 for the laſt number.

$$\begin{array}{r|l} 20 & \\ 64 & 16 \\ 44 & \end{array}$$

5 Now for the fift variety, If the laſt number and

and number of places be given, to find the common exceſſe.

THE RULE.

From the laſt number take 1, *and the remaine ſhall be the Dividend; then from the number of places alſo take* 1, *and make this later remaine the Diviſor: then the quotient of this Diviſion ſhall be the common exceſſe.*

Example, Let the numbers be 1, 4, 7, 10, 13, 16, from 16 take 1, remains 15, for the dividend, then from 6, (which is the number of places) take alſo 1, remains 5 for the Diviſor,

Now when 15 is divided by 5, the quotient is 3. And 3 is alſo the common exceſſe, or difference between 1 and 4, or 4 and 7, &c.

6 Laſtly, let the laſt number, and the common exceſſe be given to find the number of places.

THE RULE.

From the laſt number take 1, *and divide the remaine by the common exceſſe; then to the quotient adde* 1, *the ſumme is the number of places.*

As let the numbers be, 1, 5, 9, 13, 17, 21, 25 29, from 29 take 1, remains 28, which divide by 4, (which is the exceſſe) the quotient is 7, to which adde 1, the ſumme is 8, which is the number of places, as the reader may eaſily count.

Geo-

Geometrical Progreſſion.

I ſhall not be ſo large in this as in the former, becauſe theſe things are of little uſe to the Arithmetician, except where a number is to be many times doubled, tripled, or the like, which cannot be ſo eaſily abridged here, as in the other, becauſe there the laſt number ariſing of many *additions* of the exceſſe to 1, was eaſily found by one multiplication: but here the laſt number being made by many *Multiplications* of the exceſſe, is therefore many times harder then the other.

The varieties here ſhall be but two.

1 The common exceſſe, and number of places being given, to find the laſt number.

2 The exceſſe, and laſt number being given, to find the total ſumme.

The firſt of theſe may thus be found. Let the numbers be 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, the exceſſe is 2, the places 10, find out the fift number (which is eaſily done, for any one may reckon ſo farre by heart) that is here 16, and multiply 16 by 16, it produceth 256, which is the ninth number, laſtly, multiply 256 by the exceſſe 2, thence ariſeth 512, the number deſired.

So if the places had been more, as 72, having found the 9 nũber 256, multiply it by 256, thence comes 65536 for the 17th. number, which multiplied

riplied by the exceſs 2, gives 131072 for the 18th. place, which multiplied by 131072 gives 17179869184, for the 35 place; and that multiplied againe by the exceſſe 2 gives 34359738368, for the 36 place, that multiplied by 34359738368, then the product will be 1180591620717411327 424, for the 71 place, which laſtly, multiplied by the exceſſe, gives 236118324143 48226 54848, for the 72 place, which is the laſt number of the progreſſion required to be found.

Perhaps this may ſeem ſomewhat tedious but where things cannot be performed without labour, the Reader muſt content himſelfe with ſuch Rules as make it leſs; for it is certaine that this way is much ſhorter then to have multiplied ſtill by the exceſſe 71 times, which elſe he muſt have done.

All this notwithſtanding, he is not bound to uſe the ſame numbers, much leſſe in other queſtions where the number of places is not the ſame, but whereas I began from the place 9, he may begin at 8, 10, or 12, or where he pleaſes; ſo as he remembers ſtill where he is; for this is general, *if the number belonging to any place whatſoever, be multiplied by it ſelf, the Product ſhall be the number belonging to twice ſo many places want one place.*

Now for the ſecond thing, which is to find the ſumme of all the numbers.

THE RULE.

From the laſt number take the firſt, and divide the

the remaine by the exceſſe want 1, *then multiply the quotient by the exceſſe; and to the product add the firſt number, the ſumme of them is equal to the ſumme of all the numbers.*

So if from the laſt number, or 72 place be taken 1 remain is 2361183241434822654847, which ſhould be divided by 1 (that is the exceſſe want 1 for the exceſſe is but 2) but becauſe 1 neither multiplies nor divides, that labour is ſaved; Now multiply this remain by the exceſſe, the product is 4722366482869645309696, to which adding the firſt number 1, by making the figure 6 next the right hand to be 7, you have the total ſumme of all the 72 numbers.

A Queſtion reſolved by Geometrical Progreſſion.

A Londoner ſojourning in a Countrey Market Towne, in winter, made himſelfe a new freez Suit and Coat, on which were ſet 6 dozen of buttons of Silke and Silver; A Baker being in his company liked it ſo well he would buy it of him; the Citizen conſented to let him have it, paying for the firſt button a ſingle barly corn, for the ſecond 2, for the third 4, and ſo on doubling to the laſt.

The bargaine was liked on both parts for the preſent, but ſhortly after revoked, for it could not be performed, and no man can be holden to an impoſſibility:

But why this could not be performed: may be judged; firſt, by inquiring the worth of ſo much

much barly in Money: And ſecondly, the weight of it; and how it ſhould be removed.

1 For the firſt, allowing 10000 corns to a pinte (which is more then enough) then 5120000 corns make a quarter; and yet (for ſhortning the diviſion) we will allow 10000000 corns to a quarter; by which dividing the whole number of corns (which is done by cutting off the firſt 7 figures toward the right hand) the quotient will be 472239648286964, and ſo many whole quarters there are omitting the remaine, as in this caſe not conſiderable.

Now allowing barley were to be ſold at 15 *d.* the buſhel (which is cheap) it is ſo many Angels: and therefore dividing by 2 it is 2361183241414-3482 pounds ſterling: which is in words, Two hundred thirty ſix millions of millions; one hundred and eighteen thouſand three hundred twenty four millions; one hundred forty three thouſand; four hundred eighty two pounds, which I take to be too much for any Trades man to get or keep.

And reckoning land for ever, at twenty years purchaſe, if this ſumme of pounds be divided by 20, the quotient is the yearly rent of 118059-16207174 pounds.

And this divided again by 365 (the number of dayes in a yeare) the quotient 323449759 18, that is above thirty two thouſands of millions a day for ever. So great a vanity may be concluded on for want of a little premeditation.

2 Now, ſecondly, for the weight of it, if we put

put 8 buſhels to weigh 2 hundred pound weight (for ſure it doth weigh more) then the whole number of quarters multiplied by 2, gives the weight of all to be 9444732965739 28 hundred weight, and if this be divided by 20 (which is but cutting off one figure toward the right hand, and dividing the reſt by 2) or which is all one cut off one figure from the number of quarters the quotient 472236648286 96, is ſo many tuns. And therefore it will require 472236648 28 ſhips of 1000 a piece to carry it; And conſequently if every Nation in the World had above 10000 ſuch ſhips, yet there muſt be above four millions of ſuch Nations; which I ſuppoſe are not to be found in this World.

And here I will leave this; having uſed this long example, (which though it require more labour, as all great examples do, yet the ſame skill will doe it as if the places had been fewer) that the Reader being throughly exereiſed thereby, may the eaſier leap over others which are ſhorter.

The

The golden rule.

Or Rule of Three.

THis is the moſt uſefull and moſt eaſie Rule in Arithmetique, and deſerves a Golden name. It is when there are three numbers given or known to find a fourth in proportion with them.

But 4 numbers are in proportion, and called *Proportional*, when as the firſt is to the third, ſo is the ſecond to the fourth.

As if there were given, 3, 4, and 6, to find a fourth which may be to 4, as 6 is to 3, that is double, and that fourth number is 8; And this is called *Proportion direct*: and the Rule whereby it is done, *The Direct Rule.*

There is alſo another proportion called *Reciprocal*; which is when as the firſt is to the third, ſo is the fourth to the ſecond: As 3, 4, 6, and 2, this is called *The Reverſe Rule.*

In direct proportion, the product of the two middle numbers multiplied together, is ever equal to the product of the firſt and laſt multiplied together, which ſerves not onely for a Proofe, but

but a ground of the Rule, which Rule ſhall here follow: the Reverſe Rule being deferred till we have done with this.

The Rule Direct.

Multiply the ſecond terme or number by the third, and divide the product by the firſt; the quotient ſhall be the fourth number deſired.

Example. Let the three numbers given be 2, 6, 3, multiply 6 by 3 the product is 18, then divide 18 by 2, the quotient is 9, which is the fourth number in proportion with 2, 6, and 3.

For as 2 to 3, ſo 3 times 2, which is 6, is to 3 times 3, which is 9.

And ſo the product 18 divided by 2, and the quotient 9 cauſeth that the product of 2 into 9 ſhall be alſo 18, and conſequently if 2 be the firſt of the 4 proportional numbers, and 6 and 3 the two middlemoſt, then 9 is the laſt.

Otherwiſe.

Divide the ſecond by the firſt, and multiply the third by the quotient, the product ſhall be the fourth.

So if one divide 6 by 2, the quotient is 3, by which multiply 3 the product is 9, for the fourth number, as b fore, otherwiſe ſtill this Rule might be expreſſed; but where the firſt way is ſo ſhort and cleare, there many other wayes would rather trouble then helpe the perſon that ſhould uſe them.

In the firſt way (which here we mean to uſe

and no other) if the first number be 1, then the product of the second and third gives the fourth, without any divi sion. Or if the second, or third number be 1, then there needs no multiplication but dividing the greater of them by the first, the quotient (in whole numbers for yet we speak of them) is the fourth number, which was sought.

Note 1.

To know when to use the direct, or the Reverse Rule, consider, if more require more, or if lesse require still lesse, then use the direct Rule, but if more require lesse, or lesse more, then use the Reverse rule, this will be easily understood when we come to examples.

Note 2.

To know how to place the 3 numbers when they are confusedly given, remember that two of them are alwayes of one denomination, as both pounds, or both sheep, or both yards, or acres: and the other uumber hath another denomination, now know that this single number is ever the second number in order.

And one of the other two, namely that which hath some relation to this second, is the first; and the other is the third number, whose relation is sought for in the fourth, whence its plaine that the second and fourth are also of the same denomination.

And

And having premiſed theſe things, let us now exemplifie the Rule in ſome queſtions.

Queſtion 1.

If 3 yards of cloth coſt 4 *li.* what ſhall 21 yards coſt?

Set the numbers in order as in the example, if 3 yards coſt 4 *li.* what 21 yards? Here you ſee that the firſt number and the third number are both of one denomination, *viz.* both yards, and the ſecond number is of another denomination, namely pounds, wherefore the fourth number which is ſought for, muſt be alſo pounds, therefore multiplying (according to the Rule before given) the ſecond number by the third, and dividing the product by the firſt the quotient ſhall anſwer the queſtion.

Firſt, 21 multiplied by 4, (which is the third number multiplied by the ſecond produceth 84, which divided by 3 the firſt number, the quotient is 28 *li.* and ſo much ſhall 21 yards coſt: for 28 is to 4, as 21 to 3, ſeeing each containes either 7 times.

And the worke will ſtand thus

yards		*pounds*		*yards*
If 3	coſt	4	what	21
		x li.		4
		84(28		84
		3 3		

Queſtion. 2.

If 4 men eat 2 pecks of corn in a weeke, how many pecks ſhall ſerve 100 men?

Place your numbers as here you ſee, then multiply 100 by 2 (that is the third number by the ſecond, and the product is 200, which divided by 4, the quotient is 50, for the number of pecks required,

men	*pecks*	*men*
If 4	eat 2	what 100

2

200

200 (50 *pecks*

44

Queſtion 3.

If 20 ſheep coſt 13 pound 13 ſhillings 4 pence, what is that for every ſheep?

Turn the ſhillings and pounds into pence thus

	s.	*li.*
13		13
12		240
26		520
13		26
156		3120
	3120	
	156	
	4	
	3280	

Mul-

Multiply 13 *s.* by 12 the product is 156
And 13 *li.* by 240 (becauſe 240 pence make one pound) the product is 3120
To which adde the 4 *d.* 4

It makes in all 3280

Then the queſtion will be. If 20 ſheep coſt 3280 pence, what ſhall one ſheep coſt?

ſheep *pence*
If 20 coſt 3280 what 1?

x *d.*	*x d.*
3280 (164	48 *s.*
xxx0	x64 (13
	xxx
	x

By the rule before delivered, I ſhould multiply the ſecond number by the third, but in this exampl, the third number being 1, it doth not multiply; I therefore divide 3280 the ſecond number, by 20 the firſt number, and the quotient 164, is the price of one ſheep in pence, which divided by 12, the quotient is 13 *s.* and 8 *d.* remaining, the price of every ſheep therefore is 13 *s.* 8 *d.*

Queſtion 4.

How many 10 inch tiles will pave a floore that contains 16 ſquare yards?

First, remember there are 36 inches in one yard in length; which multiplied into 36 gives 1296, for the square inches in one square yard; multiply 1296 therefore by 16, thence comes 20736, the summe of all the 16 yards in inches. Secondly, seeing every tile is 10 inches in length, and 10 in breadth, multiply 10 by 10 it produceth 100 for the square inches in one tile; See the manner of worke.

```
    36        10
    36        10
  ----      ----
   216       100
  108
 -----
  1296
    16
 -----
  7776
 1296
 -----
 20736
```

Then by the golden Rule.

If 100 inches require 1 tile, what shall 20736 inches require?

inches *tile* *inches*

If 100 require 1 what 20736.

```
     0
  2 0 7 | 36(207
  1 1 1 | 00
```

Here

Here becauſe 1 doth neither multiply nor divide (as hath been ſeverall times intimated) I therefore divide the third 20736, by the firſt 100, the quotient is 207, and 36, remaining.

So it appears that 207 is too little and 208 too much to doe the worke: the juſt number being $207\frac{36}{100}$, we ſhall not trouble the reader with this till he know ſomething of fractions.

Queſtion 5.

If 100 *li.* give 6 *li.* intereſt for a yeare, how much ſhall 750 *li.* give?

Multiply 750 by 6 the product is 4500, which divided by 100, the qotient is 45 *li*, for the thing required.

li. *li.* *li.*

If 100 give 6 what 750

750
6

4500

li.

4500(45
400

Queſtion. 6.

If 750 *li.* give 45 *li.* intereſt for a year, what ſhall 100 *li.* give?

Multiply 45 by 100, the product is 4500, which divided by 750, the quotient is 6 *li.* for the interest of 100 *li.* for a yeare.

li.	*li.*	*li.*
If 750	give 45	what 100

100

4500

3

45 00 (6

750

Many other questions might be added, but the rule is so plaine that it needs them not; and so general, that he which can resolve one, may aswel resolve any other: And for that reason; and because in all the Rules which follow, this rule will be constantly made use of, I will say no more of it here.

The Golden Rule Reverse.

Question 1.

IF 12 workmen do any piece of worke in 8 moneths: how many workmen shall do the same in 2 moneths?

THE

THE RULE.

Multiply the first terme by the second; and divide the Product by the third, the quotient is the number desired.

Here 12 is not the first number, though it be first named; but the three numbers placed in order, stand thus, 8, 12, 2, for the middle terme must alwayes be of the same denomination with that whic hs requi red.

Now multiply 12 by 8, the product is 96, which divided by 2, the quotient is 48, which answers the question, As in the example,

moneths	*men*	*months*
8	12	2

8

2) 96 (48

8

16

16

0

For if 8 moneths require 12 men; then (a fourth part of 8) 2 moneths, shall require (four times 12 that is) 48 men.

For here lesse requires more, that is lesse time, more hands; and therefore is it wrought by the Reverse Rule.

Que-

Queſtion. 2.

How many Ells of Tapeſtry will ſerve to hang a roome 3 yards high, 6 yards long; and 5 yards broad; not regarding Doors, Windowes, or Chimney; but as if there were no ſuch?

Firſt, multiply 6 by 3, the product is 18, which doubled (becauſe there are 2 ſides called *lengths*) is 26 yards for all the length.

Secondly (for the ſame reaſon) multiply 3 by twice 5, that is by 10, the product is 30 yards, for all the breadth; which added to 36, gives 66 yards equal to all the length and breadth in yards.

But now becauſe Elles, that is *Flemiſh* Ells (for ſuch meaſure are hangings ſold by) is equall to 3 quarters of a yard, that is, their Ell is to our Yard as 3 to 4. Say therefore if 4 give 66 what 3? multiply 66 by 4, it produceth 264; then divide 264 by 3 the quotient is 88. Againe, multiply 88, by 4, and divide the product (which is 352) by 3, the quotient is 117, and 1 remaining, to which the diviſor 3 being applyed; the number juſtly anſwering the queſtion is 117 Ells, and one third part of an Ell.

Note 1.

Becauſe here we had to deal with things which had equal length and breadth, that is ſquare yards, and ſquare ells; therefore one multiplication and diviſion was not ſufficient to pro-

Proportion this; but if inſtead of working by 4 and 3, we had done it by their ſquares which are 16 and 9, it might have been performed at once, thus, multiply 66 by 16, product is 1056, which divided by 9, the quotient is 117⅓, as before, but I began not with this way, for I ſuppoſed my reader ignorant of ſquares.

Note 2.

It might alſo have been done, by reducing all the termes into quarters of a yard at the firſt, and after the number is found, reducing them againe to ells; but becauſe it is more proper to worke thus, when fractions have been taught, I leave that, and proceed to another queſtiou.

Queſtion. 3.

If 1 cloſe, would graze 21 horſes for 6 weeks; then (ſuppoſing no waſte to be made) how many horſes would it feed for 7 weeks?

Multiply 21 by 6 it produceth 126, which divided by 7, the quotient is 18. At that rate therefore it would keep 18 horſes for 7 weeks.

Queſtion 4.

If 1 cloſe will feed 18 horſes for 7 weeks, how long ſhall it feed 63 horſes?

Multiply (according to the rule) 18 by 7 the product is 126, which divided by 63, the quotient is 2 therefore, 2 weeks it ſhall keep them.

The

The like way ſerves for hay, oates, or any other proviſion for Man or beaſt; which may be of uſe in garriſons, and ſuch like caſes where ſcarcity may be feared, to proportion either the mouthes to the meat, or meat to mouthes.

I will ſay no more of this Rule; Neither will I treat of the double Rule of Three, as a rule by it ſelfe; but come to the Rule of 5 numbers, which is held an abridgement of the other.

The Golden Rule Compound of 5 numbers.

Queſtion 1.

IF a hundred pound weight (that is 112 pound weight) carryed 120 miles, coſt 14 *s.* how much ſhall three quarters of a hundred, (that is 84 pound) coſt, being carried 40 miles?

THE RULE.

Multiply the three laſt numbers one into another, (that is) the third by the fourth, and that product by the fifth; the laſt product ſhall be the Dividend.

Again, *Multiply the two firſt numbers together; the product ſhall be the diviſor. This Diviſion being made, the quotient will be the number of ſhillings, deſired.*

Example of the former Queſtion.

Firſt,

Firſt, place your numbers according to the tenor of the queſtion thus,

li.	*miles.*
112	120
120	
2240	
112	
13440	

s.	*li.*	*miles*
14	84	40
12		
28		
14		
168 *pence*		
84		
672		
1344		
14112		
40		
564480		

d.

13440)564480(42

53760

26880

26880

Your numbers being placed in order, reduce the 14 *s.* into pence, and it is 168 *d.* then multiply 168; by 84 the product is 14112, which multiplied by 40 the later product, it produceth 564480, for the dividend.

Then multiply 112, by 120, it produceth 13440, for the Diviſor.

Divide 564480, by 13440, the quotient will be 42 pence; which is 3 *s.* 6 *d.* and anſwers the queſtion.

In this Rule the firſt number and fourth, alſo the ſecond and fift; and alſo the third and ſixt, are of like denomination and nature.

Queſti-

Queſtion 2.

If 100 *li.* for 6 moneths yield 3 *li.* intereſt, what ſhall 625 *li.* yield for 36 moneths?

Place them, 100, 6, 3, 625, 36.

Multiply the three laſt, as before is ſhewed, the later product is 67500 for the dividend; And the firſt multiplied make 600 the Diviſor, then divide 67500 by 600 (or 675 by 6, which is all one) the quotient will be 112, whole pounds; and 300 (or 3) remaining, which becauſe it is half the diviſor, ſignifies the half of a pound; that is 10 ſhillings. So the anſwer to the queſtion is 112 *li.* 10 *s.*

li	*m.*	*li.*	*li.*	*m.*
100	6	3	625	36
6			3	
600			1875	
			36	
	x3		11250	
6)675(112			5625	
666			67500	

Which might have been given in one denomination, namely 2250 ſhillings, if before the work the pounds had been turned into ſhillings, by multiplying them by 20, as hath been ſhewed before.

But

But ſince moſt queſtions, except ſuch as are ſtudied for the purpoſe, are apt to end in ſome fraction, I ſhall next treat of fractions.

Onely firſt, having ſpoken of the double rule of Three, this may let you know, that all queſtions which are wrought at once by the compound rule of five; may be done at twice by the ſingle rule of three: and the doing of them ſo by two operations is called the double rule.

As in our laſt queſtion there are two things conſiderable, the difference of money; and the difference of time.

Firſt, for the money,

Say, if 100 *li.* give 3 *li.* what 625 *li?* anſwer $18\frac{75}{100}$ *li.*

Secondly, for the time time;

Say if 6 *mo.* give $18\frac{75}{100}$, *li.* what 36 *mo.* anſwer $112\frac{50}{100}$ *li.*

But this will be better underſtood anon; and then the reader may uſe that which he likes beſt.

Of

Of Fractions.

THe word *Fraction* ſignifies a *breaking* or *breach* of any intire thing into parts; and when a number is broken ſo, the parts (which muſt neeeds be every one leſſe then the whole; and the whole is accounted but *One* or *Unity*) being leſſe then Unity, are called fractions (that is fragments, or pieces) of Unity. Now the Unite, or intire number which is to be broken, may be any thing, as one pound, in reſpect of which, ſhillings and pence, and farthings are fractions; or one ſhilling, in reſpect of which, pence, and farthings are fractions; or one peny, in reſpect of which, farthings are fractions; and the like of weights and meaſures, or any other thing to be broken into parts.

In *Fractions* we ſhall treat firſt of *Numeration*, then of *Multiplication* and *Diviſion*, then of *Reduction*; then laſtly of *Addition* and *Subtraction*.

The reaſon of this Order will ſoon be ſeen; for Multiplication and Diviſion are here much eaſier then Addition, &c. and therefore ought to be learned before them.

Nume-

Numeration.

Numeration is nothing elſe but the way of writing Fractions; and that this may be done, we muſt conſider that any Unite, or Number repreſenting an Unite, may be broken into 2 parts equal; and then each of the parts is called *one ſecond*, or *halfe*: or it may be parted into three equal parts, and then each part is called *one third*; and two of them are called *two thirds*; and the like may be underſtood if it were parted into 4, 5, 6, 7, 8, 9, 20, 50, or 100, or how many ſoever.

Now to write theſe: doe thus

Write	one half	Thus	$\frac{1}{2}$
	one third		$\frac{1}{3}$
	one fourth		$\frac{1}{4}$
	one fifth		$\frac{1}{5}$
	one ſixth		$\frac{1}{6}$
	one ſeventh		$\frac{1}{7}$
	one eighth		$\frac{1}{8}$
	one ninth		$\frac{1}{9}$
	one tenth.		$\frac{1}{10}$

In every one of these 10 fractions, the Number below the line is called the *Denominator*, and it shews into how many parts the Unite is broken.

The Number above the line shewes how many of those parts are taken, or contained in the fraction, and is therefore called the *Numerator*. So in the fraction $\frac{3}{5}$: the Denominator 5. shewes the Unite to be broken into 5 parts; and the Numerator 3 signifies, 3 of such parts to be contained in the fraction; which fraction therefore is called *three fifths*.

And here it is plaine, that as the Numerator is in proportion to the Denominator: so is the fraction to 1, for $\frac{3}{3}$ or $\frac{5}{5}$: or any the like, is equal to 1.

And therefore all fractions are quotients of lesser numbers divided by greater, as $\frac{4}{7}$ signifies 4 to be divided by 7, and as the dividend 4, is to the divisor 7: so is the quotient $\frac{4}{7}$ to unity.

And therefor this line of separation which is drawn between the dividend and divisor doth properly signifie division,

Hitherto we have spoken onely of such fractions as are lesse then 1, and those are called *Proper fractions*: but there are also $2\frac{1}{2}$. $3\frac{3}{4}$. $5\frac{1}{7}$. $6\frac{3}{5}$. and the like mixed Numbers; which so written signifie *two and an half*, *3 and 3 quarters*, *five and a seventh*, *6 and 3 fifts*. These by multiplying the whole Numbers, by the Denominator, and to the product adding the Numerator-

respects

respectively are turned to $\frac{5}{2}$. $\frac{15}{4}$. $\frac{36}{7}$. $\frac{33}{7}$. which are called *Improper fractions*, because every one of them contains more then Unity.

These, nevertheless may be multiplyed, divided, added, or subtracted in the same way as are proper fractions. And this shall serve for Numeration of Fractions.

Multiplication.

The Rule.

Multiply all the Numerators together, the last product shall be the Numerator of the product required: Likewise multiply all the Denominators together, the last product shall be the Denominator of the product sought.

Example 1.

If $\frac{2}{5}$ be multiplyed by $\frac{4}{9}$. multiply the Numerator 2 by the Denominator 4, the product is 12, for the Numerator of the new product. Also multiplying the Denominator 5, by the Denominator 9, they produce 45. for the Denominator of the desired product, so that product which was required, is $\frac{12}{45}$.

Example 2.

If $\frac{1}{2}$. $\frac{3}{4}$. $\frac{4}{5}$. $\frac{5}{9}$. and $\frac{3}{11}$. were to be multiplyed all together, begin with the Numerators, saying, once 3 is 3, and 3 times 4 is 12, and 12 times 5 is 60, and 60 times 3 is 180, for the Numerator: Then multiply the Denominators: saying, 2 times 4 is 8, and 8 times 5 is 40, and 40 times 9 is 360, and 360 times 11 is 3960, for the new Denominator. So that the product of all these is, $\frac{180}{3960}$. that is equall to $\frac{1}{22}$. as shall be seen hereafter in Reduction.

And

And thus it appears that proper Fractions, being leſſe then one, are ſtill made leſſe by multiplying: as here the product $\frac{1}{11}$. is much leſſe then $\frac{3}{11}$. which is the leaſt multiplyer, and the reaſons hereof is plain: for ſeeing Multiplication is but the taking of a Number, a certaine number of times, if that number of times be more then 1, then the Number to be taken is increaſed by being taken more then once; but if the Number of times be 1, it is not increaſed, nor diminiſhed, but is ſtill the ſame; Laſtly, If that number of times be leſſe then 1, as $\frac{1}{2}$. the number not being taken once, but half of once, produceth a number leſſe by half; that is the half of the number to be taken; and the like reaſon is of all others.

Example 3.

Multiply the mixt Numbers $3\frac{1}{3}$. $4\frac{1}{3}$. and $5\frac{3}{4}$. Firſt, (as hath been ſhewed already) turn them to improper fractions: thus, firſt, ſay 2 times 3 is 6, and 1 is 7. So the firſt is $\frac{7}{2}$. Secondly, 3 times 4 is 12, and 1 is 13: ſo the ſecond is $\frac{13}{3}$. Laſtly, 4 times 5 is 20, and 3 is 23: ſo the laſt is $\frac{23}{4}$. Now the fractions to be multiplyed are, $\frac{7}{2}$. $\frac{13}{3}$. and $\frac{23}{4}$. Firſt, for a new Numerator, ſay, 7 times 13 is 91, and 91 times 23 is 2093. for a new Numerator.

Then ſay, 2 times 3 is 6, and 6 times 4 is 24. So the new Denominator is 24.

And the product of all theſe fractions is $\frac{2093}{24}$. that is, if reall diviſion be made, $87\frac{5}{24}$.

Diviſion.

DIviſion of one fraction by another, is but croſſe multiplication of them; that is, the Numerator of the one, by the Denominator of the other, and hereby the proportion of one fraction to another is ſeen.

Example 1.

Divide $\frac{3}{4}$. by $\frac{6}{8}$. to doe it ſet them thus: and multiply as the croſſe leads, ſaying, 3 times 8 is 24, for a new Numerator, and 6 times 4 is alſo 24, for a new Denominator; ſo the quotient is $\frac{24}{24}$. that is 1, which ſhewes the fractions to be equal one to another.

Example 2.

Divide $\frac{3}{5}$ by $\frac{4}{9}$. Firſt, ſet them thus: And ſay, 3 times 9 is 27, for a Numerator, and 5 times 4 is 20, for the Denominator: ſo the quotient is $\frac{27}{20}$ and ſo mauy times is $\frac{4}{9}$. contained in $\frac{3}{5}$. that is, as 27 is to 20, ſo is $\frac{3}{5}$ to $\frac{4}{9}$. and ſo is $\frac{27}{20}$ to 1.

In diviſion it is to be remembred that the *Numerator*,

nerator of the quotient ever ariſeth of the Numerator of the *Dividend*; And the *Denominator* of the quotient comes of the Denominator of the *Dividend*, each being croſſe multiplyed, as before.

If a Fraction be to be divided by a whole number, multiply the Denominator by that number, the product gives the new Denominator, and the Numerator remaines the ſame. So if $\frac{1}{4}$ be divided by 9, ſay 9 times 4 is 36. So the quotient is $\frac{1}{36}$.

Or if $\frac{1}{4}$ were to be multiplyed by 9, the product (by multiplying the Numerator by 9) will be $\frac{9}{4}$: that is, $2\frac{1}{4}$.

Example 3.

Divide $\frac{320}{8}$ by $\frac{45}{9}$. thus: ſay 320 times 9 is 2880. for a Numerator: And 8 times 45 is 360 for a Denominator. So the quotient is $\frac{2880}{360}$, or $\frac{8}{1}$.

For $\frac{320}{8}$ is equal to 40, and $\frac{45}{9}$ equal to 5, but 40 contains 5 eight times.

And ſo in the ſecond example, it may be proved, that as 27 to 20, ſo is $\frac{3}{5}$ to $\frac{4}{9}$. For firſt multiply the two middlemoſt, then 20 times $\frac{3}{5}$ is $\frac{60}{5}$, that is 12.

Secondly, multiply the firſt and laſt, and then 27 times $\frac{4}{9}$ is $\frac{108}{9}$: that is alſo 12.

Wherefore by that which hath been ſaid in the *Golden Rule*, the foure Numbers, 27, 20, $\frac{3}{5}$. $\frac{4}{9}$. are proportional.

Reduction.

REduction of Fractions is threefold.

1 To reduce one fraction (which is not already in the leaſt) to a leſſer Denomination.

2 To reduce many fractions of divers denominations, to one denomination.

3 To reduce any fraction, from one denomination (as neer as may be) to any other denomination deſired.

For the firſt of theſe, divide both the Numerator, and the Denominator, by the greateſt common diviſor that you can think of; the two quotients being placed reſpectively in a fraction, that fraction ſhall be equal to the former fraction, and in leſſer termes.

So (in the 2 Example of Diviſion) to reduce $\frac{2880}{360}$ to $\frac{8}{1}$. divide 2880 by 360, quotient is 8. then divide 360 by 360, the quotient is 1. and the new fraction $\frac{8}{1}$ is equal to the former fraction, $\frac{2880}{360}$. and in leſſe termes; as you may ſee. But to find the greateſt common diviſor.

The Rule is.

Divide the greater terme by the leſſer (I mean by termes,

termes, the Numerator and Denominator) *and by the remainer,* (if any be) *divide the diviſor, and* if any *thing ſtill remaines, by that divide the laſt diviſor, continuing this courſe till nothing remain greater then Unity; that diviſor which is laſt of all is the greateſt common meaſure of both termes; by which both being divided, and the quotients placed like a fraction, that fraction ſhall be equal to the former fraction, and in the leaſt termes.*

Example.

Reduce $\frac{148}{16}$ to the leaſt termes; firſt divide 148 by 16. the quotient is 9, and 4 remaines: againe, divide 16 by 4, the quotient is 4, and nothing remaines; wherefore taking 4, (the laſt diviſor) for the greateſt common diviſor, by it divide 148, the quotient is 37, and by it divide 16, the quotient is 4. Theſe two laſt quotients placed orderly in a fraction, make $\frac{37}{4}$. which is equal to $\frac{148}{16}$, and in the leaſt termes; for no number greater then 1, will divide evenly both 37, and 4.

Other wayes there are of leſſening fractions, as dividing the termes (if they be even Numbers) by 2. and the quotients (if even) again by 2, or elſe by 3, or any other Number that will divide them both evenly, that is, leave nothing remaining, but the former Rule being generall and eaſie, ſhall ſerve for all.

Now ſecondly, to reduce many Denominations to one common denominator; let the fractions be $\frac{1}{2}$. $\frac{3}{4}$. $\frac{4}{5}$. $\frac{7}{8}$. $\frac{9}{10}$. to be reduced all to the denomination 3200.

The

The Rule.

Multiply all the Denominators together : saying, 2 times 4 is 8, and 8 times 5 is 40, and 40 times 8 is 320, and 320 times 10 is 3200, this last product 3200, shall be the common Denominator. Then to get Numerators for every one of them. *Multiply every particular Numerator into all the Denominators except his owne*; As first, for the first, say, 1 time 4 is 4, and 4 times 5 is 20, and 20 times 8 is 160, and 160 times 10 is 1600.

For the first Numerator; so the first fraction reduced is, $\frac{1600}{3200}$. Then for the second Numerator: say, 3 times 2 is 6, and 6 times 5 is 30, and 30 times 8 is 240, and 240 times 10 is 2400. So the second fraction reduced, is $\frac{2400}{3200}$. After the same manner may the other three be reduced to $\frac{2560}{3200}$. for the third: $\frac{2800}{3200}$. for the fourth: and $\frac{2880}{3200}$. for the last; these are severally equal to the other, the first to the first, &c. as may be proved thus:

Let the Unity be a pound *sterling*, then

		s.		
The	$\frac{1}{2}$ of it is	10		
	and $\frac{3}{4}$ is	15		
	and $\frac{4}{5}$ is	16	*d.*	
	and $\frac{7}{8}$ is	17	6	
	and $\frac{9}{10}$ is	18		
		s.	d.	
In all		76	6	

That is 3 whole Unites, and 16. *s.* 6. *d.* over. Turn 16. *s.* 6. *d.* all to six pences, it is 33. and because

becauſe *6. d.* is the fortieth part of a pound, therefore all the fractions are equal to $3\frac{33}{40}$.

Now adde the new Fractions (which being all of one denomination) may be added like whole Number: thus

	1600
	2400
	2560
	2800
	2880
In all	12240.

Which divided by the Denominator 3200, the quotient is $3\frac{2640}{3200}$. Now $\frac{2640}{3200}$. reduced to the leaſt termes, as hath been ſhewed how it may, will be $\frac{33}{40}$. ſo the ſum of theſe alſo is $3\frac{33}{40}$. which is equal to the ſum of the fractions given to be reduced; and therefore they are equal in ſum; and might be thus proved equal ſeverally, that is, the firſt of them propounded, to the firſt reduced. Divide the Numerator 1600. by the Nnmerator 1. quotient is, 1600. Alſo divide the Denominator 3200. by the Denominator 2, the quotient is alſo 1600. and ſo may any of the reſt be proved equal by the equality of quotients. But I leave it as plaine enough already.

Thirdly, Any fraction being given, to change the denomination to any other more requiſite; retaining ſtill (as neer as may be) the ſame value.

The Rule.

Multiply the Numerator given by the Denomina-

tor.

tor required, and divide the product by the Denominator given; the Quotient ſhall be the Numerator required.

Example.

Let the Fraction given be $\frac{7}{13}$ of a pound *ſterling*, what is that in twentieth parts, or ſhillings? Multiply 7 by 20, the product is 140, which divided by 13, the quotient $10\frac{10}{13}$. that is, 10 *s.* and $\frac{10}{13}$. of a ſhilling: which may be brought to pence thus, multiply 10 by 12, product is 120, which divided by 13 quotient $9\frac{3}{13}$ *d.* And againe, multiply 3 by 4, the product is 12, which divided by 13 quotient is $\frac{12}{13}$ of a farthing, ſo ſeuen thirteenths of a pound is 10 *s.* 9 *d.* and almoſt a farthing.

But he which is reſolved to have it in the ſmalleſt coine, may do it at firſt worke; for ſeeing a farthing is the 960. part of a pound, multiply 7 by 960, they produce 6720, which divided by 13, the quotient is 516 farthings, and $\frac{12}{13}$ of a farthing: theſe farthings may be turned to ſhillings, dividing by 48, or to pence by 4.

This Rule though it be briefe and plaine, is of great uſe in Arithmetique; either for turning Natural and ſurd Fractions into Declimals; or any other deſired Denomination, with ſuch facility and ſpeed as may be wiſhed.

Fractions of Fractions.

In reduction of Fractions, ſome make another, or more parts, as fractions of fractions for one: that is, when there is a part of a fraction, or a part of

of a part of a fraction, &c. to be valued in one fraction.

The Rule.

Multiply all the Numerators together, the last product shall be the Numerator desired: then multiply all the Denominators together, and this last product shall be the Denominator sought.

Example.

Let the Fractions of Fractions propounded be $\frac{4}{5}$ of $\frac{3}{4}$ of $\frac{1}{3}$. for so they are usually written; and let the Numerator be multiplyed: saying, 4 times 3 is 12, and 12 times 1 is 12, the Numerator therefore required is 12: then for the Denominator: say, 5 times 4 is 20, and 20 times 2 is 40, for the Denominator required; and $\frac{12}{40}$ is equal to $\frac{4}{5}$ of $\frac{3}{4}$ of $\frac{1}{3}$.

Proof.

Let the Unite be 40. *s.* one fifth of 40 is 8, and therefore $\frac{4}{5}$ is 32, of which one fourth is 8, and $\frac{3}{4}$ is 24, of which one half is 12, and therefore $\frac{12}{40}$ is the just sum of all the Fractions. This needs no further exemplifying.

Addition.

Addition.

TO adde many fractions into one ſum, conſider whether they be of one Denomination or divers; if of one, then adde all the Numerators together into one ſumme, that ſumme is the new Numerator: and the denominator, in this caſe is not altered.

Example.

Let the fractions to be added be $\frac{2}{4}$. $\frac{4}{4}$. $\frac{5}{4}$. $\frac{1}{4}$. Adde the Numerators: ſaying, 2 and 4 is 6, and 6 and 5 is 11, and 11 and 1 is 12, So the ſumme of them all is $\frac{12}{4}$, that is 3 Unites.

As, let the Unite be 20 *s.* one fourth is 5 *s.* and $\frac{2}{4}$ is 10 *s.* and $\frac{4}{4}$ is 20 *s.* which added to 10 *s.* is 30 *s.* then $\frac{5}{4}$. is 25 *s.* which added to thirty ſhillings gives 55 *s.* And laſtly, $\frac{1}{4}$ is 5 *s.* which added to 55 *s.* makes 60 *s.* that is 3 times 20 *s.* that is 3 *l.* or 3 Unites.

But if the fractions to be added, be of divers denominations, as let them be $\frac{2}{3}$. $\frac{3}{4}$. $\frac{4}{5}$. $\frac{7}{8}$. then (by the reduction afore-going) they muſt be turned all into one denomination, and then they will

will be $\frac{320}{480}$. $\frac{360}{480}$. $\frac{384}{480}$. and $\frac{420}{480}$. and may be added like those before: thus,

	320
	360
	384
	420
In all	1484

So the summe of all is $\frac{1484}{480}$. or $\frac{371}{120}$. that is, $3\frac{11}{120}$. which if it be money and the Unite 1 *l.* it is then 3 *l.* 1 *s.* and 10 *d.* as may be tryed thus: First, $\frac{2}{3}$ of a pound, is 13 *s.* and 4 *d.* & $\frac{3}{4}$ is 15 *s.* and $\frac{4}{5}$ is 16 *s.* Lastly, $\frac{7}{8}$ is 17 *s.* 6 *d.* These all added together, the summe is 3 *l.* 1 *s.* 10 *d.*

Subtraction.

Subtraction.

IN Subtraction of one fraction from another, if they be both of one denomination; it is done by taking the Numerator of one from the Numerator of the other, the remaine is the new Numerator, and the Denominator the ſame as before.

So if $\frac{2}{5}$ be ſubtracted from $\frac{8}{5}$, the remain is, $\frac{6}{5}$, the like of all others.

But if they be not of one Denomination, they muſt firſt be reduced to be ſo: then that which is ſaid before is ſufficient.

The golden Rule in Fractions is the ſame as in whole Numbers, I will give you but one inſtance.

If $\frac{3}{4}$ of a yard of tape coſt $\frac{1}{2}$ of a peny, what ſhall one inch, that is, $\frac{1}{36}$ of a yard coſt?

Multiply the ſecond by the third, the product is $\frac{1}{72}$, which divided by $\frac{3}{4}$, the quotient is $\frac{4}{216}$ of a penny, for the price $\frac{1}{36}$ of a yard.

Otherwiſe,

Seeing $\frac{3}{4}$ of a yard, may be turned to 27 inches;

ches; Say, if 27 coſt $\frac{1}{2}$, what 1? divide $\frac{1}{2}$ by 27, it makes $\frac{1}{54}$ for the anſwer: which is equal to $\frac{4}{216}$, and in the leaſt termes.

And whereſoever this may be done, to have the firſt and third Numbers fractions of one denomination, the beſt way is to work with their Numerators, not regarding their denominator at all: as if $\frac{2}{3}$ coſt $\frac{3}{4}$, what $\frac{7}{5}$? inſtead thereof write, if 2 coſt 3, what 7? multiply $\frac{3}{4}$ by 7, it produceth $\frac{21}{4}$, which divided by 2, the quotient is $\frac{21}{8}$, and that is the anſwer in the leaſt terms.

And all this while it ſhould have been noted, that the fractions are ever written in a ſmaller figure then the whole Numbers.

The Rule of Fellowſhip.

THis Rule is uſefull for Merchants, and all ſuch as trade in Companies, with a joint ſtock; and muſt ſhare a proportional part of the gaines, or loſſe; every one according to his ſtock which he laid in.

The Rule is two-fold, with *equal* time; or with *unequal* time.

That which is with equal time, is commonly called, The Rule of Fellowſhip *without time*.

Of this we will firſt ſpeak.

The Rule.

As the whole joint ſtock, is to all the gain or loſſe; So is each mans particular ſtock; to his part of the gaine, or loſſe.

Example 1.

Two Merchants A. and B. buy 700 *l.* a yeare Land for ever, (when money is at 8, *per cent.*) for 14000 *l.* of which A. paid 8000 *l.* and B. 6000 *l.* after 5 yeares (money being fallen to 6 *p. Cent*) they

they ſell it for 18700 *l.* ſo there is gained 4700 *l.* how much of this muſt A. have?

Firſt, for A.

Say, if 14000 gaine 4700, what 8000? anſwer, 2685 $\frac{10000}{14000}$.

Then for B.

If 14000, gaine 4700, what 6000? anſwer, 2014 $\frac{4000}{14000}$. As by the following operation doth appeare.

(I) For A.

l. *l.* *l.*

If 14000, gain 4700, what 8000.

8

14000) 37600000 (2685 $\frac{10000}{14000}$

28000

96000

84000

120000

112000

80000

70000

10000 remainer.

(II) For B.

l. *l.* *l.*

If 14000 gaine 4700, what 6000.

6

14000) 28200000 (2014 $\frac{4000}{14000}$

28000

20000

14000

60000

56000

4000 remainer.

Here note, that this work might have been much abreviated, if from each of the 3 numbers you had cut off two Cyphers towards the right hand, as hath been formerly shewed in the Compendium of *Multiplication* and *Division*.

Now for the proofe hereof,

If you adde 2685 $\frac{10000}{14000}$

which is the sum that A. gained;

To—— 2014 $\frac{4000}{14000}$.

The summe of them is 4700.

Which is equal to the totall gain.

And according to the proportion of these two Numbers: that is, as 8 to 6, or 4 to 3. So they ought to have parted the yearly rent also, all the time they received it: that is, A. ought to have 400 *l.* yearly; and B. 300*l.*

Example

Examgle 2.

A. B. and C. joyne their moneys to make a ſtock of 25000 *l.* of which A. laid in 10000 *l.* B. 8000 *l.* and C. put in 7000 *l.* with this (after a certain time in trading) they gained 7500 *l.* how muſt this be parted?

First for A,

Say, if 25000 gaine 7500, what 10000?

Or ſhorter, if 25 get 7 $\frac{1}{2}$, what 10? Multiply 7 $\frac{1}{2}$ by 10, it produceth 75, which divided by 25, the quotient is 3, that is, (reſtoring the 3 Cyphers) 3000 *l.* for A.

Then for B.

Say, if 25000 gaine 7500, what 8000?

Or ſhorter, if 250 get 75, what 80.

Multiply and divide as the *Golden Rule* requires, and to the quotient, reſtore the 2 Cyphers, then it will be 2400 *l.* for B.

Laſtly, for C.

Say, if 250 give 75, what 70? anſwer 21, to which put the 2 Cyphers, it makes 2100 for C.

And theſe three 3000, 2400, and 2100, being added together, make 7500. And have that proportion as the particular ſtocks had: and therefore the work is right.

(I) for A.

If 25 gaine $7\frac{1}{2}$, what 10 *s.*

150

$7\frac{1}{2}$ $\frac{15}{2}$ $\frac{10}{1}$

2

$\cancel{1}$
$\cancel{1}\cancel{5}\cancel{0}$ (75
$\cancel{2}\cancel{2}$

$\cancel{1}$
$\cancel{7}\cancel{5}$ (3
$\cancel{2}\cancel{5}$

3000 *l.* for A.

(II) for B.

If 2500 gaine 75, what 80?

80

250)6000(24

500
1000

1000

2400 for B.

(III)

(III) for C.

If 250 gaine 75, what 70?

70

250) 5250 (21

500

250

250

2100 for C.

And if inſtead of gaining 7500 *l.* whereby every one is ſuppoſed to have his ſtock, and a part of the gaines; they had loſt 7500 *l.* then their particular ſtocks had not been due to them, but ſo much as would be left after their proportional parts of the loſſe were abated.

Example 3.

A. B and C. with a joynt ſtock of 25000 *l.* gaine 7500: of which A. gets 3000. B. 2400. C. 2100, what was their ſtocks?

This is but the Converſe of the former, therefore ſay, if 7500 require 25000, what doth 3000 require? 10000 for A. and ſo work for the other two.

Many examples are of little uſe, (except to load the Readers memory) where the Rule is ſo ſhort and plaine, I will therefore adde no more to this part of the Rule, but immediately come to the Rule of Fellowſhip with time.

The Rule of Fellowſhip with time.

THis Rule is to be uſed when the times of the continuance of the particular ſtocks are unequal, and differ; ſo that here the difference of time, and alſo the differeuce of ſtock being both to be conſidered; it can be done no better way then by taking the Power of them both to be the particular ſtock; and all thoſe Powers added, to be the whole ſtock, that which I call the Power, is the product of the money of every one, multiplyed by his time; And then

The Rule.

As the ſumme of thoſe Products, is to the whole gain: ſo is each particular product, to its part of the gain.

Queſtion 1.

Three Merchants, A. B. C. make a ſtock of 10000 *l.* of which A. layes in 4000 for 3 months, B. 3000 *l.* for 6 months; and C. 3000 *l.* for 8 months, with this they gaine 2000 *l.* what is each mans ſhare?

Firſt,

Firſt, for A. multiply 4000 by 3, it makes 12000, let that be accounted his particular ſtock.

Secondly, for B. multiply 3000 by 6, it makes 18000.

Laſtly, for C. multiply 3000 by 8, it produceth 24000, for his ſtock, adde theſe, they make 54000 *l.* for the generall ſtock; then ſay,

For A.

If 54000 give 2000, what 12000? anſwer, $444\frac{24000}{54000}$.

Then for B.

If 54000 give 2000, what 18000? anſwer, $666\frac{36000}{54000}$.

Laſtly, for C.

If 54000 give 2000, what 24000? anſwer, $888\frac{48000}{54000}$.

The 3 Fractions may be reduced (by dividing each Numerator, and Denominator by 6000) and then the 3 ſhares will be $444\frac{4}{9}$ $666\frac{6}{9}$. and $888\frac{8}{9}$. which altogether make 2000, as they ought.

Queſt. 2.

Three Farmers, A. B. and C. lay out 1000 *l.* to ſtock their grounds with Cattel, of which A. put in 200 *l.* for 6 yeares; B. had 300 *l.* going for 4 yeares; and C. 500 *l.* for 2 years; at the end (by unſeaſonable times) there was loſt 200 *l.* which made the remain of their ſtock but 800 *l.* what had each man left?

Multiply 200 by 6, it gives 1200: Likewiſe, 300 by 4, it gives 1200. Laſtly, 500 by 2, the product is 1000: all theſe are 3400 for the joynt ſtock. Then

Then first for A.

Say, if 3400 loſe 200, what 1200? anſwer, 70 $\frac{2000}{3400}$ for A, to which B is equal, becauſe the power of his ſtock is ſo.

Therefore for C.

Say, if 3400 loſe 200, what 1000? anſwer, 58 $\frac{2800}{3400}$. So the 3 ſhares are 70 $\frac{20}{34}$. 70 $\frac{20}{34}$. and 28 $\frac{18}{34}$, equal to 200.

Now becauſe A put in 200 *l.*, and loſt 70 $\frac{20}{34}$, ſubtract the loſſe from the ſtock, remains 129 $\frac{14}{34}$.

And ſo doing for B, his remain will be 280 $\frac{14}{34}$.

And for C. his remain is 441 $\frac{6}{34}$. Now theſe three remaines, 129 $\frac{14}{34}$, 229 $\frac{14}{34}$, and 441 $\frac{6}{34}$, make up 800 *l.* which was the whole remain.

Queſt. 3.

A. rents a cloſe for a year to pay 80 *l.* he puts into it 200 ſheep: 2 months after B. puts 40 ſheep in; and 5 months after that C. puts in 100 ſheep; how much muſt every one pay of the rent?

Multiply 200 by 12, it produceth	2400
And 40 by 10, produceth,	400
Laſtly, 100 by 5, (which is C time) produceth	500
In all	3300

Then for A.

If 3300 pay 80, what 2400? anſwer, 58 $\frac{600}{3300}$.

Then for B.

If 3300 pay 80, what 400? anſwer, 9 $\frac{2300}{3300}$.

And for C.

If 3300 pay 80, what 500? anſwer, 12 $\frac{400}{3300}$.

The whole numbers make 79, and the broken numbers make 1. In all 80.

Note.

Note.

Whereas, hitherto we have conſidered onely difference of *time* and *money*; it may be noted, that there may be differences of other kinds, as *perſons* or *place*; but whatſoever they are the power of all is found like theſe by multiplication; and are to be worked like theſe, with ſo many uſes of the *Golden Rule*, as the queſtion requires. I will therefore adde but one queſtion more, which is this.

Queſt. 4.

One leaves a Legacy of 900 *l.* among foure Kinsfolks. A. B. C. D; ſo as B may have twice as much as A. and C thrice as much as B. and D as much and half as much as C. what is every one to have?

Say, if A be 1, B is 2, C 6, and D 9, add theſe Numbers: 1, 2, 6, 9 together, they give 18, then ſay, If 18 require 900, what 1? anſwer is 50. So A is to have 50 *l.* B 100 *l.* C 300 *l.* and D 450 *l.* which are their juſt parts; and altogether are equal to 900 *l.* and the work right.

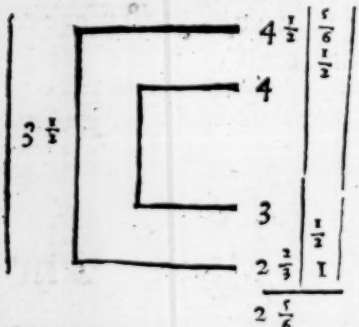
The

The Rule of Alligation.

THis hath its name from *binding*, tying, or uniting many particulars in one Maſſe or Summe, the nature of it will be underſtood in working ſome Queſtions or Examples.

Queſt. 1.

A Corne Maſter would mix 4 ſorts of graine together, *viz.* wheat at 4 *s.* the buſhel, wheat at 4 *s.* 6 *d.* the buſhel; Rie, at 3 *s.* the buſhel, and Barly at 2 *s.* 8 *d.* the buſhel; ſo as to make 15 quarters in all, to be ſold at 3 *s.* 6 *d.* the buſhel; How much muſt he take of each?



Place them as in the Margin, ſo as a greater and leſſer may ſtill be together, as 4 ½, with 2 ⅔ and 4 with 3, and place the price required by it ſelfe toward the left hand, as here you ſee 3 ½ then in a ſeparated Columne note the difference between the price of a buſhel of every one particular given, and a buſhel of that reqnired, as the difference

difference betwixt 4 ½ and 3 ⅓ is 1, which muſt not be placed againſt 4 ⅓, but againſt that number linked with 4 ⅚, that is, againſt 2 ⅔, and ſo muſt all the differences be ordered, as is eaſie to be ſeen in the Margine: then

The Rule.

Multiply the whole Maſſe to be made, by any particular difference; and divide the product by the ſumme of all the differences, the quotient ſhall be the juſt quantity of that particular kind, whoſe price ſtandeth againſt the difference you worked with.

Example.

Firſt turne the quarters into buſhels, by ſaying, 8 times 15 is 120: then for the quantity of the firſt ſort at 4 ½: multiply 120 by ⅚, the product is 100, which divided by 2 ⅚, the quotient is 35 ⅝ buſhels of that ſort at 4 *s.* 6 *d.* and working ſo for every of the other; they wil be found to be thus:

At 4 *s.* 6 *d.*	35 ⅝	
At 4 *s.*	21 ³⁄₁₇	buſhels.
At 3 *s.* 6 *d.*	21 ³⁄₁₇	
At 2 *s.* 8 *d.*	42 ⅔	
In all	120	buſhels.

Now to prove this right; firſt multiply the whole Maſſe 120 buſhels, by the deſired price, 3 ½, *s.* omitting the denominations, the ſumme is 420 *s.*

Then

Then ſecondly, multiply 35 $\frac{5}{17}$ by 4 $\frac{1}{3}$, it is, $158\frac{14}{17}$

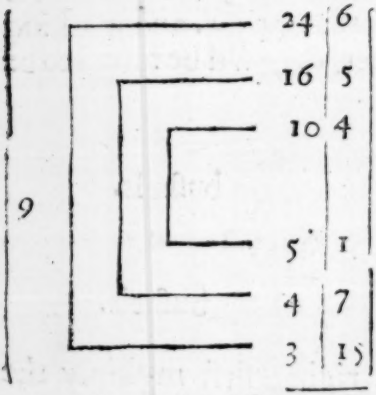
And 21 $\frac{3}{17}$ by 4, it produces $84\frac{12}{17}$
And 21 $\frac{3}{17}$ by 3, it makes $63\frac{9}{17}$
And 42 $\frac{6}{17}$ by 2 $\frac{2}{3}$, is $112\frac{16}{17}$

In all 420

But ſo much all ſhould be worth in ſhillings. And therefore the queſtion is rightly ſolved.

Queſt. 2.

One hath 6 ſorts of Fruits at ſeverall prices, Dates at 2 *s.* Almonds at 1 *s.* 4 *d.* Currance at 10 *d.* Raiſons at 5 *d.* Prunes at 4 *d.* and Figs at 2 *d.* the pound; and would take of every ſort ſome to make a mixed quantity of 30 *l.* weight to ſell one with another for 9 *d.* the pound, how much muſt he take of each?



Having placed the Numbers & their differences, and the ſum of thoſe differences diſtinctly as hath beene ſhewed before, and may be ſeen by the figure in the Margine: the worke is evermore like that in the former queſtion. So 28 is the firſt number in the *Golden Rule*; 30, the ſecond

cond (which that may not be forgotten may be ſet at the right ſide of the figure) & every particular difference, as 6,5,4, &c. is the third, the Rule to be repeated till all the differences have been employed.

So 30, multiplyed by 6, produceth 180, which Divided by 38, the quotient is $4\frac{28}{38}$ of a pound weight: and ſo much muſt be taken of Dates, at 24 *d.*

Secondly, 5 times 30 is 150, which divided by 38, the quotient is $3\frac{36}{38}$ for Almonds. And working after the ſame manner with 4, 1, 7, 15, their reſpective quantities will be found to be theſe;

	poun.	38 parts.
Dates	4,	28
Almonds	3,	36
Currance	3,	6
Raiſons	0,	30
Prunes	5,	20
Figges	11,	32
In all	26,	152

That is 26 $\frac{152}{38}$, and the reduction of the fraction will make it 30, as it ought to be, and by comparing the prices of theſe particulars added, with the price of 30 *l.* weight, at 9 *d.* per. *l.* weight. which makes 270 *d.* this may be proved like the former.

But that the Reader may be perfect in it, I will doe it here alſo, as followeth.

Say firſt, 24 times 4 is 96, and 24 times 28 is

is 672: for the first, set them thus: 96, 672

And 16 times 3 is 48, and 16 times 36 is 576	48, 576
And 10 times 3 is 30, and 10 times 6 is 60	30, 60
And 5 times 30 is 150	00, 150
And 4 times 5 is 20, and 4 times 20 is 80	20, 80
Lastly, 3 times 11 is 33, and 3 times 32 is 96	32, 96
In all	227, 1634

Now this, 1634 being the summe of the Numerators of Fractions, whose common denominator is 38, must be divided by 38, and the quotient will be 43, which added to the whole number 227: the summe is 270. And so much is 30 multiplyed by 9, which shewes the work to be right.

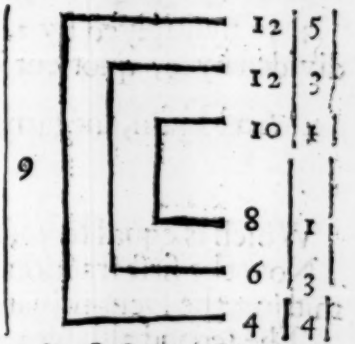
The Combination, or linking of Numbers may be varied at pleasure, as whereas above I linked 24, and 3, also 16 with 4, and 10 with 5, it might have been 24 with 5, and 16 with 4, and 10 with 3. Or 24 with 4, and 16 with 3, and 10 with 4, of which diversity of linking would follow diversity of solutions, but all true, as the Reader may easily prove by himself.

Likewise, if the Numbers to be linked were 3, 5, 7, or any odd Number, one of them may be linked to two severally, to make the worke even.

Example.

Example 3.

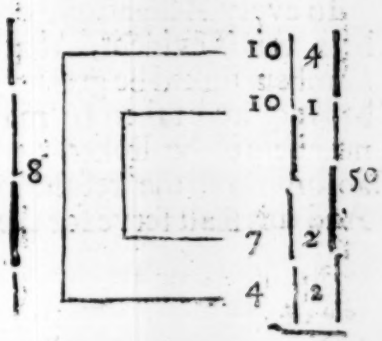
If the Numbers were 12, 10, 8, 6 and 4, and the meane or common price required were 9, you might firſt linke them as you ſee here, taking 12 twice, or elſe you might take any other twice as you ſhall like; and ſo the worke will be every way right, though not the ſame; if the differences be rightly ſet off and orderly uſed, as is taught before in the firſt Queſtion.



Queſt. 3.

A Goldſmith would mix 3 ſorts of ſilver, A. B. C. A is 10 *d.* weight better; B 7 *d.* weight better; and C 4 *d.* weight better, to make an Ingot of 50 *l.* weight, which ſhould be in fineſs 8 *d.* weight better: How much muſt be taken of each

Set them, their differences, and the ſumme of their differences as in the Margine.



K Then

1 Then firſt, 50 multiplyed by 4, and divided by 9, quotient is $\frac{200}{9}$

2 50 multiplyed by 1, and divided by 9, quotient is $\frac{50}{9}$

3 50 multiplyed by 2, and divided by 9, quotient is $\frac{100}{9}$

4 And again, the ſame $\frac{100}{9}$

In all $\frac{450}{9}$

Which is equal to 50, the quantity required.

Now the firſt fraction multiplyed by 10, (omitting the Denominator) is 2000

The ſecond alſo by 10 gives 500

The third by 7 makes 700

The laſt by 4 makes 400

In all 3600

That is, $\frac{3600}{9}$ which is equal to 400, and if the whole Ingot 50, be multiplyed by the betterneſſe required, namely, by 8, they ſhall produce 400 alſo: So this is proved.

In every Alligation, or linking of two numbers, this is evident, that if the ſumme of the numbers linked be greater then the mean Number required taken ſo many times as there are numbers to be linked, the queſtion would be abſurd; and the reſolution thereof impoſſible. And this ſhall ſerve for the rule of Alligation.

The

The Rule of False Position.

THis Rule ſerves to reſolve queſtions, which are not preſently fit for the *Golden Rule*; and therefore in ſtead of the true Number which is ſought: Suppoſe any number great or ſmall, and make triall of it, whether it reſolve the queſtion without any errour; if ſo, it is the true Number: if not, note what errour is at the end of the worke, and whether it be too much or too little; if too much, marke it thus + but if too little, thus —

Then ſuppoſe againe another Number, (it imports not whether it be neerer or further off) and try as before, and marke that errour alſo;

And then

The Rule.

Multiply the firſt Poſition by the ſecond Errour, and the ſecond Poſition by the firſt errour, and (if the errours be both + or both —) *Subtract the leſſer product from the greater, and keep the remaine for a Dividend; and the difference of the errours for the*

Divisor; the quotient of that division is the true Number required.

But if the errours had been one + the other − then the summe of the products added together had been the Dividend: and the summe of the errours the Divisor, the rest of the work the same as before.

Question 1.

A man is to drive 48 yong Turkies 40 miles; and for every Turkie which comes alive to the end of the journey, he is to receive 3 *d.* but for every one which dyes by the way, he is to pay 6 *d.* at the end, he received 72 *d.* How many dyed by the way?

Let the first supposition be
That by the way there dyed 20
For them he was to pay 120 *d.* and for
28 which lived, he was to receive 84 *d.*
so he paid more then he received 36 *d.*
and should have got cleare 72 *d.*

Adde 108

Wherefore the first errour is −108

Let the second supposition be 10
For these he paid 60 *d.* and for the rest he received 114 *d.* the difference is 54, and should be 72: so the second errour is −18

Now 20 multiplyed by 18, produceth 360
and 10 by 108 produceth 1080

and the difference is 720 for the Dividend, likewise the difference of the errours is 90 for the Divisor, and the quotient is 8, which is the true Number of those he lost by the way. As may be proved by trial

Quest. 2.

Queſtion 2.

If it were required to make up a Pound *ſterling* of ſhillings and groats onely; and ſo as the number of groats, may be to the Number of ſhillings, as 7 to 1, how many ſhillings muſt there be?

Firſt, ſuppoſe the ſhillings	4
then the groats muſt be equal to 16 *s.* that is 48 groats; but the ſhillings taken 7 times are 28, to which 48 ſhould be equal, but is	+ 20
Secondly, ſuppoſe the ſhillings	2
then the groats (making 18 *s.*) are 25, which ſhould be equal to 7 times 2, but is	+ 40
Multiply 4 by 40 product is 160, then Multiply 2 by 20, the product is 40, which taken from 160, reſts for the Dividend	120
And the difference of errours is	20
Laſtly, 120 divided by 20, quotient is	6
The number of ſhillings therefore is	6
And the number of groats is	42

But as 7 to 1, ſo is 6 times 7 which is 42 to 6 times 1 which is 6: ſo the work is done.

Queſt. 3.

If there be 4 ſeveral weights, A. B. C. D. of which D is 24 ounces, and C is double to B, and triple to A, and D with twice A is double to C, and quadruple to B: How much doth every one of theſe weights weigh?

First,

First, suppose A to be 8
then D with twice A is 24, and 16, that is 40
of which C being the halfe is 20, and B 10
Now thrice A is 24, to which C should be
equal, but is —4
Secondly, let A be supposed 4
then D, more twice A, is 32, and C 16
and B is 8, but thrice A is 12, to which 16
should be equal, but is +4

Then 8 multiplyed by 4, gives 32, and 4 by 4, produceth 16: both these products gives 48 for the Dividend; and the summe of the errours (becaus the first is —, the other +) gives 8, for the Divisor; and the quotient will be 6, to which A is equal, and twice A more, D is 36, of which C, (being halfe is 18, and B is 9, and thrice A is equal to C, namely 18, and all right.

Whereas the first errour is equal here to the second, it followes that the Positions were equally false: and therefore their difference which is 4, being parted into 2 equal parts, 2 and 2, if 2 be taken from 8, the remaine is the true number 6, or if 2, be added to 4, (which was the second position) the summe will be also 6.

And further, whensoever the errours be one +. the other —. though they be not equal; yet then if the difference between the positions be parted into 2 parts, which are in proportion one to another, as the two errours are one to another respectively: then if the first part be taken from the first position (if that be the greater) or adde to it (if it be the lesse, the same Number required is thereby had.

As

As, let the last question be resumed,
And let the first position for A be 15
Then the first errour will be — 18
Then let the second position be 3
And so the second errour will be + 6
And the difference of positions is 12,
which divided into 2 parts 9 and 3, which have that proportion one to another as have the errours 18 and 6, then if the first part 9, be taken from the first position 15, there remains the true Number 6. Or else if the second part 3 be added to the second position 3: thereby also is made the true Number 6.

The way of parting 12, (or any other) into two parts proportional with the errours is easily done by the *Golden Rule*, thus:

As the summe of the Errours 24
is to the difference of positions 12
So is the greater errour 18
to the greater part required, namely, 9.

Many other questions are in other bookes exemplified and wrought by this Rule; but seeing I intend not to write a great booke; and also becauſe some of those questions may be easily resolved without this Rule, I will adde no more: onely mention one of those questions.

If there be a Cisterne with 4 Cocks, which holds 8 barrels of water, and the first cock will run it all out in 6 houres, the second in 4, the third in 3, and the last in 2 houres: in what time shall all of them runne it out?

If the first in 6 houres runne	8
the second in the same time would run	12
the third	16
the last	24
In all	60

Then say, if 60 require 6 : what 8 ?

The answer $\frac{48}{60}$, that is $\frac{4}{5}$ of an hour ; in which time all the 4 Cocks together would run out all the 8 barrels of water.

The

The Rule of Ceres and Virginum.

THis is the moſt uncertaine, and unneceſſary Rule in Arithmetique; being ſeldome uſed except in ſporting queſtions, to puzzle yong beginners, with eaſie problems; ſuch as follow.

Queſt. 1.

A Caterer bought 8 birds of 2 ſorts, as Geeſe and Henns for 20 *s.* the Geeſe coſt 4 *s.* a piece, the Hens 2 *s.* a piece; How many did he buy of each ſort?

This may be done by the Rule of Falſe; and alſo thus: *multiply the whole number* 8 *into the leaſt price* 2, it produceth 16, *which taken from the whole price* 20, *reſts* 4 *for a Dividend; which divided by* 2, *which is the difference of the particular prices, the quotient is* 2, *for the number of Geeſe; and* 6 *muſt be for the Hens:* the proofe is eaſie.

Queſt. 2.

If 21 Perſons, Men, Women and Children ſpend

ſpend 26 ſhillings; ſo that every man payes 2 *s.* every woman 1 *s.* every child 6 *d.* How many is there of each ſort?

The Rule.

Multiply the number of Perſons by the leaſt expenſe, and take the product of it from the whole expenſe, the reſt ſhall be the Dividend; which divided by the difference betwixt the greateſt and leaſt particular expences: the quotient is a Number which the Number of men (or they which ſpend moſt) comes neer to: but cannot exceed: or if the ſaid Dividend be divided by the ſumme of the greateſt and leaſt expences, the quotient is a Number, then which the Number of men (or thoſe which ſpend moſt) *cannot be much leſſe.*

So here 21 multiplyed by 6 *d.* that is, by $\frac{1}{2}$, the product is 10 $\frac{1}{2}$, which taken from 26, reſts 15 $\frac{1}{2}$, for the Dividend; and then taking $\frac{1}{2}$ from 2, reſts 1 $\frac{1}{2}$ for the Diviſor, and the quotient is $\frac{31}{3}$, which is ſomething more then 10, the Number of men therefore muſt be but 9.

Then turne the Dividend, and the Diviſor both into whole Numbers, by multiplying them by the common Denominator 2, ſo they reduced will be 31 and 3, as before is to be ſeen in the quotient.

Multiply the Diviſor 3, by 9, (which is the Number of Men) the product is 27, which taken from 31, (which is the reduced Dividend) the remaine is 4, for the Number of Women; and the Children muſt be 8.

Example

Example.

9	men at 2 *s.* each	18 *s.*
4	women at 1 *s.* each	4
8	children at 6 *d.* each	4
In all	21	In all	26

But the number of men may be also 8, which multiplyed by the reduced Divisor 3, product is 24, which taken from 31, the remaine is 7 for the women; and then the children must be 6.

Example 2.

8	men at 2 *s.* each	16
7	women at 1 *s.* each	7
6	children at 6 *d.* each	3
In all	21	In all	26

Or the number of men may be 7, which multiplyed by 3, produceth 21, which taken from 31, remaines 10 for the women; and 4 children.

Example 3.

7	men at 2 *s.* each	14 *s.*
10	women at 1 *s.* each	10
4	children at 6 *d.* each	2
In all	21		26

So here is already seen 3 various solutions of this

this queſtion, which makes this Rule the leſſe to be regarded. But further, the number of men may be 10 and not more, for if you put them 11, that multiplyed by 3, produceth 33, which is greater then 31, from which it ſhould be taken, but I ſay it may be 10, and then there is only one woman, and 5 children: this confirmes the former part of the Rule.

Now for the later part, if the Dividend 31 be divided by the ſumme of the two extreme expenſes (reduced by doubling as the Dividend is) 4, the quotient will be $7\frac{3}{4}$. And the men may be 7, as hath been ſhewed; but they may be alſo but 6, and fewer they cannot be: as 6 men, 13 women, and 2 children; for if you put them 5, that multiplyed by 3, produceth 15, which taken from 31, there remaines 16 for the women, and ſo there ſhould be no children: which is contrary to the ſuppoſition.

And further, becauſe the quotient was $7\frac{3}{4}$, the number of men might be ſo, if pure Arithmetical diviſion be onely regarded: and then the women alſo are in number $7\frac{3}{4}$, and the children $5\frac{1}{2}$, as may eaſily be tryed; I need not exemplifie it.

Queſt. 3.

If there be an Exhibition of 900 *l.* *per annum* to 30 perſons: ſome Clerks, ſome meſſengers, and ſome door-keepers, at 60 *l.* each Clerk, 40 *l.* each meſſenger, and 20 *l.* each door-keeper, how many muſt there be of each ſort?

Multiply (according to the Rule) 30 by 20, the product is 600, which taken from 900, remains

mains 300 for the Dividend; and 60 want 20, that is, 40, for the Diviſor: and the quotient is 7 $\frac{1}{3}$, and more the Clerks cannot be; Alſo divide by 60 more 20, that is 80, quotient is 3 $\frac{3}{4}$, and much fewer the Clerks cannot be.

Not to ſtand upon the Fractions (in this caſe of dividing men) the Clerks may be 7, 6, 5, 4, or 3: and the meſſengers 1, 3, 5, 7, or 9, and the Door-keepers 22, 21, 20, 19, or 18, that the Clerks cannot (in whole Numbers) be more then 7, or leſſe then 3. may thus be proved; Firſt, let them be 8, then 8 times 40 is 320, which is more then 300, out of which it ſhould be taken: Secondly, let them be 2, then 2 times 40 is 80, out of 300 remains 220, which divided by 20, gives the quotient 11, for the meſſengers; ſo the clerks and meſſengers being 13, the remaine thereof to 30, namely 17 muſt be door-keepers.

but,

2	Clerks at 60 *l.* each	120 *l.*
11	Meſſengers at 40 *l.* each	480
17	Door-keepers at 20 *l.* each	340
In all 30		In all 940

Which is 40 *l.* too much, therefore the Clerks cannot be two.

Note.

It may be asked, why the remaine 220 ſhould be divided by 20: whereas the like remaine in the former Example, namely 16, was taken (without any diviſion) abſolutely for the number

ber of women, or middle number? I answer, although the greatest or first Number being found, (as here to be 2) the residue of 2 to 30, might be rightly parted into 2 fit parts in the same manner as the first question of this Rule was resolved, or else by the Rule of false: yet to give further satisfaction, the cause of this is, the difference betwixt the 2 lesser expences, was there $\frac{1}{2}$ which (before the division) was reduced to 1, which neither multiplies nor divides any Number, but leaves it the same: whereas, in this last, the middle expense (or exhibition) being 40, and the least 20, the difference of them was 20, by which dividing the Remaine of the last subtraction: the quotient is ever the Number of the middle persons. Which may serve as an addition to the Rule, where the sorts of things are but three.

Quest. 4.

If there be 10 persons of 4 severall Countries, *English*, *French*, *Dutch*, and *Spanish*, to pay a Debt of 1000 *l.* So that every English man payes 50 *l.* every French man 70 *l.* every Dutch man 130 *l.* and every Spaniard 150 *l.* How many is there of each?

The Dividend, (accordiug to the former Rule) is 500.

Now to make the Divisor, take his summe that payes least (namely 50) out of each of the other three 150, 130, and 70, and the Remaines will be 100, 80, and 20.

Add the first and last for the Divisor, it is 120.

And the quotient will be $4\frac{2}{12}$, and the Spaniard cannot be more.

Secondly,

Secondly, adde the first and second together for the Divisor; it is 180, and the quotient is $2\frac{14}{19}$, and the Spaniards cannot be lesse.

I meane, they cannot be much more then 4, or lesse then 2: and therefore, seeing any one solution will serve, let them be 3, and by that multiply 100, and take the product out of 500, there remaines 200 for a second Dividend, which divided by (the second remain) 80, the quotient is $2\frac{1}{2}$: therefore the Dutchmen are 2, which multiplyed by 80, make 160, take that out of 200, there remaines 40 for a third Dividend: which divided by (the third remaine) 20, the quotient is 2 for the French-men also; and consequently the English must be 3, because all of them are 10. But the Spaniards may be also 4 or 2.

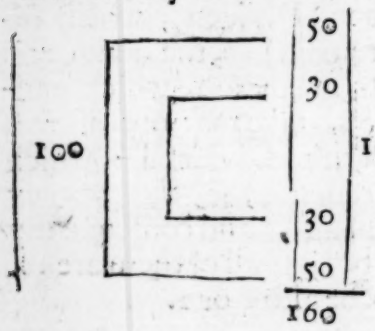
Example.

4	Spaniards, at 150 *l.* each	600
1	Dutchman at 130 *l*	130
1	Frenchman, at 70 *l.*	70
4	English, at 50 *l.* each	200
10	In all	1000

2	Spaniards at 150 *l.* each	300
3	Dutch, at 130 *l.* each	390
3	French, at 70 *l.* each	210
2	English, at 50 *l.* each	100
10	In all	1000

The

The reaſon why the Spaniards and Engliſh, as alſo the Dutch and French are equal in number, is becauſe their payments differ equally from 100, which is the mean ſumme with which 10 men ſhould pay 1000 *l.* and making it ſo, this queſtion, and many other of this nature may be anſwered by the Rule of Alligation: thus,



If 160 give 10, what 50? Anſwer is $3\frac{20}{160}$, (that is in this caſe 3) for the Spaniards, and as many for the Engliſh, becauſe their reſpective differences from 100, the one 50 more; the Engliſh 50, leſſe are equal.

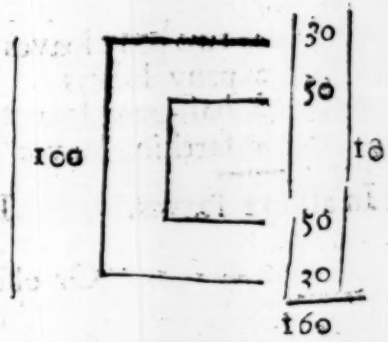
And alſo, becauſe the other two differences 30 and 30 are equal: the Number of the French is equal to the Number of the Dutch.

But both thoſe numbers together are 4, becauſe 3 Spaniards, and 3 Engliſh taken out of 10, the remaine muſt be 4.

Wherefore the Number of the French is 2, and the Dutch alſo are 2.

Or thus

Or thus



Accounting the men in the ſame order as before.

If 160 require 10, what 30?

Anſwer is 1 $\frac{140}{160}$, (that is, in this caſe 2) for the Spaniards; and conſequently 2 Engliſh, and therefore the French and Dutch each 7.

But where any one of the particular ſummes, is equal to the mean ſumme, there this cannot ſo well be done by Alligation.

Example.

If one ſhould buy 12 loaves of bread for 12 pence, ſo that ſome might be two-peny; ſome peny; ſome half-peny; and ſome farthing loaves: and it be required to know how many he muſt buy of each; then becauſe of 12 loaves for 12 pence, the meane price is 1, but one of the particulars being alſo 1, there ſhould be no peny loaves, becauſe there is no difference betwixt the meane price, and a peny.

But it may be found by the Rule of *Ceres* and *Virginum*, to be either.

4	two peny loaves	8 pence
2	peny loaves	2 pence
2	half-peny loaves	1 peny
4	farthing loaves	1 peny
In all 12	loaves.	In all 12 pence.

Or elſe,

3	two peny loaves	6 *d.*
4	peny loaves	4
3	half-peny loaves	1 $\frac{1}{2}$
2	farthing loaves	0 $\frac{1}{2}$
In all 12		In all 12

Extraction

Extraction of Roots.

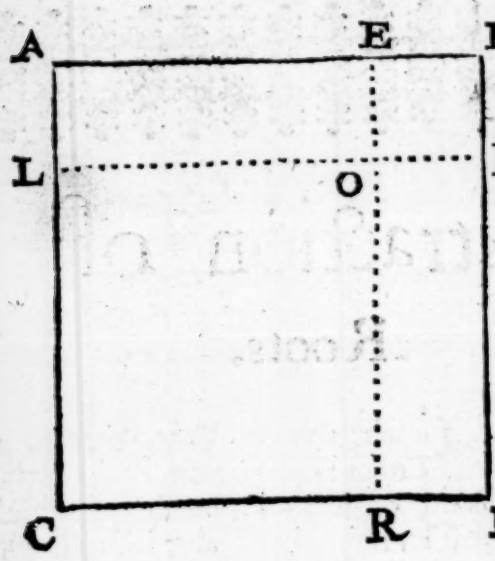
AND firſt for the ſquare Root, that is, a ſquare Number being given, to finde the root or ſide of it in a Number: which root or ſide, being multiplyed into it ſelf, muſt therefore produce that ſquare Number.

The doing of this is ſhewed in (almoſt) all books of Arithmetique; and the reaſon of it (in ſome) which is taken from the fourth propoſition of the ſecond book of *Euclide*; which ſaith,

If a right line be divided by chance; the ſquares made of the parts, together with the Reſtangle made of the parts twice, is equal to the ſquare of the whole.

Example.

Let the line A B, be divided by chance in the point E, it is manifeſt that the ſquare of A B, that is the ſquare A B D C, is equal to the ſquare of L O, that is, of A E, and to the



ſquare of E B, and to the two rectangle figures A O and D O. that is, the rectangle A O (which is made of the parts A E, and B E) twice according to the propoſition.

Now let A B, be ſuppoſed 20. A E 15. and B E 5.

Then the ſquare of A B, (which is made by multiplying the root 20 into it ſelfe) is equal to 400.

And the ſquare A E, that is, 15 times 15 is equal to 225

And the ſquare of B E is 5 times 5 25

And the rectangle A O, 5 times 15 75

And the rectangle D O, 5 times 15 75

In all 400

which is equal to the ſquare of A B, as before.

If therefore a ſquare Number, as 334084 be given

given to have the root extracted: first, make a point over 4, (the place of Unity) and another over 0, the second figure from it; and so another over 3, the second figure from 0, towards the left hand, observing the like order still if there were more secondary figures, point them all as in the Margine;

Then looke at the figures under the first point towards the left hand, which are 33, and take the greatest square root of them, which is 5. (for 6 times 6 is 36) and say 5 times 5 is 25. which take out of 33, there remaines 0840 84

Then multiply the root 5 by 20, it gives 100 for a Divisor; and the Dividend is 840, namely, the figures which reach to the next point, and so the quotient might be 8, but must be but 7, because the square of the quotient, being now 49, must (together with 7 times the Divisor) be taken out of 840.

And the remainer will be 0091 84

Adde this last quotient 7, being put to the former quotient 5, after the manner used in plain division, it will be 57, which multiply still by 20, the product is 1140 for a new Divisor, and the Dividend (because there remaines but one point) is all the figures 9184.

3 3 4 0 8 4.	
2 5	
7 4 9	
9 8 4	
0 0 0 0	

And the quotient can be but 8, and muſt be ſo much; for 8 times 1140 is 9120
and 8 times 8 is 64
In all 9184

Which taken out of the remaine 9184, there now remaines nothing: which ſhews the ſquare 334084 is juſtly reſolved, and putting the laſt quotient 8 to the two former, 5 and 7, the whole will be 578, which is the true root required.

And the parts of it, if they be 3, are 500, 70, and 8. Or if but two 570 and 8. And the truth may be either way proved by adding the ſquares and twice the rectangles of the parts; for the ſum of them ſhall be equal to the whole ſquare 334084, as hath been ſhewed before.

It is ever certaine that there ſhall be as many figures, or places of figures in the root, as there are points in the ſquare, ordered as before.

And by reading this little ſeriouſly, may any one be able to find the root of any other ſquare whatſoever: the firſt operation in all being to take the greateſt ſquare contained under that point next the left hand, and put the root thereof for the firſt figure in a quotient.

The ſecondary operation, muſt be repeated ſo often as there are remaining points; as hath been plainly ſhewed in the foregoing Example.

I will therefore adde no more, but give you two other ſquares, and their roots, leaving the Reader to extract them himſelf.

So,

So, if there were given the ſquare 8 8 2 6
The root of it according to the former practiſe may be found to be 94.

Or let there be given the ſquare 1 5 2 2 7 5 6.
The root of that will be 1234.

Extraction of the Cube Root.

A Cube is a ſolid, or Body contained within ſix equal ſquares; and may be fitly repreſented by a Die.

When a Cube is given, as is 435195112; point the Number as you ſee in the place of Unity, and every third figure after; then ſee what is the root of the greateſt Cube contained under the firſt point toward the left hand; that is, in 435, it will be found 7, (for 8 times 8, taken 8 times, is 512, which is too much) put this 7 for the firſt figure in the quotient, having taken the Cube thereof, which is 343,

out of 435: thus,

435195112	
343	
092195112	

And the remaine will be

And ſo the firſt work is done.

For the ſecond, take the ſquare of the quotient, that is 49, which mul-

multiply by 300, the product is 14700
to which add 30 times 7, that is ::210
which makes the Diviſor 14910
And the Dividend is 92519
So the quotient might be 6, but muſt be but 5, becauſe the Cube of the new quotient and 210 times the ſquare of the ſaid quotient muſt be allowed in this worke, as followeth.

The remaine is 92519512
multiply the firſt product 14700 by 78875
The ſecond quotient 5, and they produce 73500
then multiply 210 by the ſquare of 5, it makes :5250
to which add the cube of 5 ...::125
It makes in all 78875

Which taken from 92519 there remaines 13644512
and the quotient is 75, whoſe ſquare 5625, multiplyed by 300
the product is 1687500
ſecondly, 30 times 75 is ::2250
And the new Diviſor is 1710000
And the third quotient figure is 8,

by

by which multiply 1687500, it is 13500000
Likewiſe, 2250, multiplyed by the ſquare of 8, (64) is 144000
And the Cube of 8 is ::: 512

Altogether are 13644512

which taken from the ſecond remaine, there remaines now thirdly nothing. And therefore the laſt quotient 8, put to the former two, it is 758 for the whole Root, as may be tryed by multiplying 758 into it ſelfe; and the product againe by 758, then the laſt product ſhall be equal to the whole Cube, which was given at firſt to be reſolved.

The end of the firſt Part.

The ſecond Part,
Containing
DECIMALL
ARITHMETICK.

HAving in the firſt Part of this Book exemplified Art of the vulgar Arithmetick both in whole Numbers and Fractions; We come now to treat of Decimall Arithmetick, which teacheth how to performe (as; it were) in whole Numbers, all that the former did effect by Fractions. I will not inſiſt upon the antiquity or excellency of this kind of Arithmetick, but come immediately to the practice thereof, and ſhall therefore premiſe theſe Propoſitions following.

Propoſition 1.

A vulgar Fraction being given, how to reduce the ſame into a Decimall.

The Rule.

To the Numerator of the Fraction given, adde what number of Cyphers you pleaſe; then divide the Numerator by the Denominator, the quotient ſhall be the Decimall fraction required.

Example.

Let it be required to reduce $\frac{4}{17}$ into a Decimall: firſt, to the Numerator 4, adde five Cyphers, ſo will it be 400000, divide this number by the Denominator 17, and the quotient will be · 23529, which is the Decimall required.

¶ And here note, that Decimall fractions are not written in a ſmaller figure with a line between them, as vulgar fractions are, but of the ſame figure, onely there muſt be a Comma put betweene the whole Number and the Fraction, and that is the diſtinction.

Example. If you would expreſſe $235\frac{4}{17}$ in a dicimall way, it muſt be written as followeth.

By the laſt example you finde that $\frac{4}{17}$ reduced to a decimall, was · 23529, therefore $235\frac{4}{17}$ muſt be written thus: 235, 23529, In decimall fractions, the Numerator is onely expreſſed, and the Denominator onely intimated; for this is generall, *Of how many figures ſoever the Numerator*

…r of a decimal fraction doth conſiſt, of ſo many Cy-…bers with a Unite before them, doth the Denominator …the ſame fraction conſiſt. So this decimal 12,625, if it were written in a vulgar way, would be 12. $\frac{625}{1000}$, but in a decimal, onely 12,625, the Comma between 12 and 625 diſtinguiſheth the whole number from the fraction, and the fraction 625 conſiſting of three figures, intimates that the Denominator thereof muſt conſiſt of three Cyphers and an Unite before them; So the decimal above expreſſed, 2[illegible]5,23529, if it were written in the vulgar way, would be 225 $\frac{23529}{10000}$.

But it ſufficeth to expreſſe in decimals the Numerators onely, and omit the denominators, the Denominators of all decimal fractions being either 10, 100, 1000, 10000, 100000, &c. according to the number of figures contained in the Numerators.

According to this Rule, you ſhall find that

$\frac{4}{5}$	will be in decimals by adding 5 Cyphers	.80000
12 $\frac{3}{7}$		12.42857
132, $\frac{9}{17}$		132.52941

And by this means, all manner of fractions of Coynes, Weights, and Meaſures, may be reduced from vulgar fractions, to decimal fractions: as by the next Propoſition will appear.

Propoſition 2.

How to expreſſe Engliſh Coin, in Decimal Numbers.

Let it be required to expreſſe 9 ſhillings (which is $\frac{9}{20}$ of a pound *Sterling*) in a decimall, To the numerator 9 adde Cyphers, making it 900, which divide by 20, the quotient is .45 for the decimal of 9 *s.* So the decimal of 13 *s.* will be .65 *l.* and ſo for any number of ſhillings. Here

¶ Here note, that in the Reduction of Vulgar fractions into Decimals, that many times first, ſecond or third places of the Decimal fractions are Cyphers, as in the following Table the Decimal of one farthing is 00104167, and the reaſon is, becauſe if yon reduce $\frac{1}{960}$ into Decimal (for one farthing is the 960 part of a pound *Sterling*) you ſhall by adding of Cyphers to the Numerator) find the Quotient to be 104167, but two Cyphers muſt be placed before it; becauſe dividing 1000000 by 960 the place of unites in the Diviſor at the firſt demand extendeth unto the third Cypher in the Dividend, for in reducing of Vulgar fractions to Decimals, this is, A general Rule.

That if the place of unites in the Diviſor, at the firſt demand extend but unto the firſt of the Cyphers annexed to the Numerator of the fraction, there muſt be no Cypher put before the Quotient, but if the place of unites extend unto the ſecond Cypher added, then one Cypher muſt be placed before the Quotient, if unto the third Cypher, then two Cyphers muſt be placed before the Quotient, &c.

According to which Rule, if you make triall you ſhall find that the Decimal of 7 *s.* will be 35, the Decimal of 5 *d.* will be .02083333, the Decimal of two farthings will be .00208333, as in the Table.

By theſe rules laſt delivered are the enſuing Tables of Engliſh Money, Weight, and Meaſure compoſed, and the like may be done for any forreign Coin, &c. according as every mans occaſions ſhall require.

The

The TABLE of *English Coyne* in Decimals.

English Coin.	
Sh. 19	95
18	9
17	85
16	8
15	75
14	7
13	65
12	6
11	55
10	5
9	45
8	4
7	35
6	3
5	25
4	2
3	15
2	1
1	05

D. 11	04583333
10	04166667
9	0375
8	03333333
7	02916667
6	025
5	02083333
4	01666667
3	0125
2	00833333
1	00416667
F. 3	003125
2	00208333
1	00104167

Troy Waight in Decimals.

O. 11	91666667
10	83333333
9	75

	8	66666667		
	7	58333333		
	6	5		
	5	41666667		
	4	33333333	Gr.	23 00399395
	3	25		22 00381944
	2	16666667		21 00364583
	1	08333333		20 00347222
				19 00329861
P.	19	07916667		18 003125
	18	075		17 00295139
	17	07083333		16 00277778
	16	06666667		15 00260417
	15	0625		14 00243056
	14	05833333		13 00225694
	13	05416667		12 00208333
	12	05		11 00190972
	11	04583333		10 00173611
	10	04166667		9 0015625
	9	0375		8 00138889
	8	03333333		7 00121528
	7	02916667		6 00104166
	6	025		5 00086805
	5	02083333		4 00069444
	4	01666667		3 00052083
	3	0125		2 00034722
	2	00833333		1 00017361
	1	00416667		

Averdupois great weight in Decimals.

3 *qu.*		75
2 *qu.*		5
1 *qu.*		25
lib.	27	24107142
	26	23214285
	25	22321428
	24	21428571
	23	20535714
	22	19642857
	21	1875
	20	17857143
	19	16964286
	18	16071428
	17	15178571
	16	14285714
	15	13392857
	14	125
	13	11607143
	12	10714286
	11	09821428
	10	08928571
	9	08035714
	8	07142857
	7	0625
	6	05357143
	5	04464286
	4	03571428
	3	02678571
	2	01785714
	1	00892857
Oun.	15	00837053
	14	0078125
	13	00725446
	12	00669643
	11	00613839
	10	00558035
	9	00502232
	8	00446429
	7	00390625
	6	00334821
	5	00279018
	4	00223214
	3	00167411
	2	00111607
	1	00055804
5 *qu.*		00041853
halfe		00027902
1 *qu.*		00013951

Averdupois little weight in Decimals.

Ounces.	15	9375
	14	875
	13	8125
	12	75
	11	6875
	10	625
	9	5625
	8	5
	7	4375
	6	375
	5	3125
	4	25
	3	1875
	2	125
	1	0625
Drams.	15	05859375
	14	0546875
	13	05078115
	12	046875
	11	04296875
	10	0390625
	9	03515625
	8	03125
	7	02734375
	6	0234375
	5	01953125
	4	015625
	3	01171875
	2	0078125
	1	00390625
3 qu.		00292969
half		00195312
1 qu.		00097656

Liquid Measures in Decimals.

P.	7	875
	6	75
	5	625
	4	5
	3	375
	2	25
	1	125
3 qu.		09375
halfe.		0625
1 qu.		03125

Dry

Dry Measures in Decimals.

Bushels.	7	875
	6	75
	5	625
	4	5
	3	375
	2	25
	1	125
Pecks.	3	09375
	2	0625
	1	03125
3 *qu.*		0234375
halfe.		815625
1 *qu.*		0078125
Pints.	3	0058594
	2	0039063
	1	0019531

Long Measures, the Integers being yards and ells, in Decimals.

qu.	3	75
	2	5
	1	25
nale.	3	1875
	2	125
	1	0625
3 *qu.*		046875
halfe.		03125
1 *qu.*		015625

Time in Decimals.

Mo.	11	916667
	10	833333
	9	75
	8	666667
	7	833333
	6	5
	5	416667
	4	333333
	3	25
	2	166667
	1	083333
Da.	30	082193
	29	097454
	28	076714
	27	073973
	26	071233
	25	068495

24	065755
23	063016
22	060274
21	057536
20	054795
19	052055
18	049316
17	046577
16	043837
15	041097
14	038357
13	035617
12	032877
11	030137
10	027397
9	024657
8	021918
7	019178
6	016438
5	013698
4	010959
3	0082192
2	0054795
1	0027397

Dozens in Decimals.

De.	11	9166667
	10	8333333
	9	75
	8	6666667
	7	5833333
	6	5
	5	4166667
	4	3333333
	3	25
	2	1666667
	1	0833333
Pa.	11	076388
	10	0694444
	9	0625
	8	0555555
	7	0486111
	6	0416667
	5	0347222
	4	0277778
	3	0208333
	2	0138889
	1	0069444

The

The uſe of the foregoing Tables.

The Tables preceding are in number nine; The firſt being of *Engliſh Coyne*, the ſecond of *Troy weight*, the third of *Averdupois great weight*, the fourth of *Averdupois little weight*, the fifth of *Liquid Meaſures*, the ſixth of *Dry meaſures*, the ſeventh of *Long meaſures*, the eighth of *Time*, and the ninth of *Dozens*: Theſe ſeverall Tables are made by the Rules immediately going before them, and their uſe is to expreſs in Decimal numbers either Money, Weight, or Meaſure, as by the following Propoſitions will appear.

PROP. I.

How to expreſs Engliſh Coin in Decimals.

The firſt of the nine Tables is for this purpoſe, therefore if you would expreſſe either *ſhillings*, *pence*, *or farthings* in Decimal numbers, you muſt repair to the firſt Table, which is of Engliſh Coyn, and there againſt 13 ſhill: you ſhall finde 65. which is the Decimall of 13 s. alſo againſt ſeven pence you ſhall finde 02916667, which is the Decimal repreſenting 7 pence: Alſo againſt 2 farthings you ſhall find

00208333, which is the Decimal answering to 12 farthings, and the like is to bee done for any other number of shillings, pence, or farthings.

¶ But if it be required to finde the Decimall of divers Denominations of Coin in one sum, as of shillings, pence, and farthings together, you must adde the Decimalls of all the particulars together, and the sum of them shall be the Decimal sought.

Example.

If you would know the Decimal of 13 *s.* 7 *d.* 2 *q.* in one number you must first look in the Table for the Decimall of 13 *s.* which is 65. and set that down, then look for the Decimal of 7 *d.* which is 02916667, and set that downe also: Lastly, seeke the Decimal of 2 *q.* which is 00208333, set that down also; then if you add these three numbers together, as in common Addition, you shall find the sum of them to be 68125000, which is the Decimall belonging to 13 *s.* 7 *d.* 2 *q.* as by the work in the Margent appeareth.

65
02916667
00208333
68125000

PROP.

PROP. II.

How to expreſs Troy weight in Decimalls.

The ſecond Table is of Troy weight, the ſeverall Denominations whereof are Ounces, Peny-weights, and Grains: So that by the Table you ſhall find that the Decimal belonging to five ounces is 41666667, the Decimall belonging to 17 peny-weight, is 07083333, and the Decimall belonging to 13 Grains is 0022569⁴, and ſo of any other number of ounces, peny-weigts, and grains ſeverally.

But if it were required to expreſſe theſe (or any other) ſeverall Denominations in one Decimal Fraction, then you muſt (as before you did for money) take out of the Table the ſeveral Decimals belonging to the reſpective quantities, and adde them together, ſo ſhall the ſum of that addition be the Decimal ſought,

Example.

If it were required to finde a Decimal which ſhould repreſent 5 ounces, 17 peny-weight, 13 grains, you muſt firſt look in the Table for the Decimal belonging to five ounces, which is 41666667, and write it down, then looke the Decimal belonging to 17 grains, which is

 07083333

07083333, and write that down, then look for the Decimall of 13 grains, which is 00225694, and write that downe, then adding theſe three numbers together, you ſhall finde the ſum of them to be 48975694, which is the Decimall repreſenting 5 ounces, 17 grains, 13 peny-weight, as by the operation in the Margent appeareth.

41666667
07083333
00225694
48975694

PROP. III.

How to expreſs Averdupois great weight in Decimals.

This *Averdupois* great weight is the third Table, the ſeverall Denominations whereof are Quarters of hundreds, Pounds, Ounces, and Quarters of Ounces, thus you ſhall finde in the Table that the Decimal of 3 Quarters of a hundred is 75, the Decimall of 22 pounds is 1964285, the Decimal of 7 ounces is 00390625, and the Decimal of 3 quarters of an Ounce is 00041853, in this manner by the Table may you finde the correſpondent Decimall belonging to any number of Quarters, Pounds, Ounces, and parts of ounces ſeverally.

But if it be required to finde one Decimall number which ſhall repreſent divers Denominations,

nations, you muſt firſt finde the Decimall belonging to the ſeveral particulars, and add them together, the ſum whereof ſhall be the entire Decimal required.

Example.

Let it be required to finde a Decimal which ſhall repreſent 3 quarters, 22 pounds, 7 ounces $\frac{3}{4}$. Firſt, look in the Table for the Decimal of three quarters of a hundred, which is 75, and write it down, then look for the Decimal of 22 pound which is 19642857, and write that down, alſo look the Decimal belonging to 7 ounces, which is 00390625, and write that down: Laſtly, ſeek the Decimal of three quarters of an ounce, which is 00041853, and write that downe, then adding theſe 4 numbers together, you ſhall finde their ſum to be 95075335, which is the Decimal repreſenting 3 qu. 22 *lb*. 7 oun. $\frac{3}{4}$.

75
19642857
00390625
00041853
95075335

PROP. IV.

How to expreſſe Averdupois little weight in Decimals.

The fourth Table is of *Averdupois* little weight, the denominations whereof are Ounces,

ces, Drams, and quarters of Drams, ſo that the Decimall of 11 ounces is 6875, the Decimal of 5 drams is 01953125, and the decimal of one quarter of a dram is 00097656.

But if it be required to finde one decimall number, which ſhall repreſent 11 ounces, $5\frac{1}{4}$ drams, then you muſt firſt look for the decimal belonging to 11 ounces, which is 6875, and ſet it down, then look for the Decimal anſwering to 5 drams, which is 01953125, and ſet that down. Laſtly, look the decimall belonging to a quarter of a dram, and ſet that down; theſe three numbers being added together, produce 70800781, which is the correſpondent decimal belonging to 11 ounces, 5 drams, and a quarter of a dram.

6875
01953125
00097656
70800781

PROP. V.

How to expreſſe Liquid meaſures in Decimalls.

Becauſe there is ſo great variety of Liquid meaſures, that hardly any two commodities are ſold by the ſame, the difference of the gallon continually making alteration, wee have therefore in this fifth Table made the greateſt denomination to be one Gallon, the next leſſe denomination being pints and quarters of pints,

ſo

ſo that in the Table you ſhall finde the Decimal belonging to three pints, to be 375, and the Decimal belonging to two quarts, or halfe a pinte, to be 0625, and ſo for any other.

But for to expreſſe pints and parts of pints in one entire decimal number, you mu adde the decimals of the ſeverall denominations together, and their ſumme ſhall be the entire decimall.

So if you were to expreſſe 3 pints and an halfe in one entire decimall number, adde the decimal of three pints, which is 375, to the decimall of two quarters, which is 0625. and their ſum 4375, ſhall be the decimall of three pints and an halfe.

375
0625
4375

PROP. VI.

How to expreſſe dry meaſures in Demalls.

The ſixth Table is of dry meaſures, the ſeverall Denominations whereof are buſhels, Pecks, quarters of Pecks, and Pints, ſo may you find the decimall of five buſhels to be 625, the decimall of two pecks to be 0625, the decimall of three quarters of a peck to be 0234375, the decimall of two pints to be 0039063. Thus are the correſpondent decimals belonging to the ſeve-

ra ll

rall denominations found: But if you would have one number to expreſſe five buſhels, 2 ¼ pecks, two pints, you muſt firſt finde the decimall belonging to five pecks, which is 625, and write it down, then finde the decimall of two pecks, which is 0625, then ſeek the decimall of three quarters of a peck, which is 0234375, and write that down. Laſtly, ſeek the decimall of two pints, which is 0039063, which numbers being added together, produce 7148438, which is the decimall belonging (or expreſſing) 5 buſhells, 2 ¼ pecks, and two pints.

625
0625
0234375
0039063
7148438

PROP. VII.

How to expreſs long meaſures in Decimalls.

The ſeventh Table is of long meaſures, the integers being Yards and Ells; and the leſſer denominations are quarters of Yards or Ells, Nales, and quarters of Nales. So may you find in the Table that the decimall of three quarters of a Yard, or an Ell is 75, the decimall of two Nales, is 125, and the decimall of one quarter of a Nale is 015625.

But if you would have one number to expreſs 3 quarters of a Yard, or an Ell, two Nales, and one

one quarter of a Nale, you muſt firſt ſeeke the decimall of 3 quarters of a Yard or Ell, which is 75, and write it downe, likewiſe ſeek the decimall of two Nales, which is 125, and write that down. Laſtly, ſeeke the decimall of one quarter of a Nale, which is 015625, and write that down, theſe 8 numbers added together, make 890625, which is the decimall belonging to 3 quarters of a Yard or Ell, two Nales, and one quarter of a Nale.

75
125
015625
890625

PROP. VIII.

How to expreſs the parts of Time *in Decimals.*

Time is uſually divided into Years, Moneths, and Dayes: So in this eighth Table of Time, which conſiſteth of theſe two denominations, Moneths and Dayes, you may finde that the decimall of five moneths is 416667, the decimal of 26 dayes is 071233. Theſe are the particular decimals, but the compound decimall number repreſenting five moneths, 26 dayes, is 487900 as you ſhall finde, if you adde 071233, which is the decimall of 26 days, to 416667, which is the decimall of five moneths.

PROP.

PROP. IX.

How to expreſs Dozens in Decimalls.

The laſt Table is of Dozens, the integer being a Croſſe, and the ſmaller denominations are Dozens, and parts of Dozens, ſo may you finde the decimall of 7 dozen to be 5833333, and the decimall of five parts of a dozen to be 0347222, and theſe two numbers added together, make 6220555, which is the number which repreſenteth 7 dozen, and $\frac{5}{12}$ parts of a dozen.

Hitherto we have ſhewed the uſe of the foregoing Tables in expreſſing of Fractions in decimall numbers, It reſteth now to ſhew the uſe of them in finding what fraction either of money, weight, or meaſure, any decimall number given doth repreſent, and that ſhall be made evident by the enſuing Propoſitions.

PROP. X.

A decimal number being given, how to finde what Fraction it doth repreſent.

Let 0291666 7 be a decimall number, repreſenting ſome Fraction part of Engliſh Coyn, be-

cauſe

cauſe it is required to finde the value of this Fraction in Engliſh Coyn, you muſt therefore repair to the Table of Engliſh Coyn, in the ſecond column of which Table ſeek for the number given (*viz.* 02916667) which you ſhall finde to ſtand againſt 7 pence, and ſo much is the value of the decimall Fraction 02916667, in Engliſh Coyn.

Alſo if the decimall Fraction 75 were given, you ſhall finde the value thereof to be 15 ſhillings, and the value of 003125 to be three farthings.

Likewiſe in the Table of Troy weight, if 41666667 were given, it would ſignifie five ounces, and 05416667 would expreſſe 13 penyweight, and 00173611 will expreſſe ten grains, &c.

After this manner may you finde the value of any decimall number given, either in Money, Weight, or Meaſure, when the number given may be exactly found in the Table: But if the number given cannot be found exactly in the Table unto which it is directed, then you muſt finde in the ſame Table, the neereſt number you can leſſe then the given number, and take the number that anſwers unto it in the firſt Column, which will be the greateſt fraction of the number required: Then ſubtracting the decimall thus found, out of the decimall given, you ſhall have a remainder, which remainder ſeek alſo in the ſecond Column of the Table, if it may be found; if not, ſeeke the neereſt leſſe,

and

and the number answering thereunto in the first Column shall be the next greatest fraction; then subtracting this decimal found out of the former remainder, there will be another remainder, which also seek in the Table, and proceed as in the former: An Example or two will make all plain.

Example 1.

Let 68125000 be a Decimal given, representing some part of English Coyn. If you look in the Table of English Coyn for 68125000, you cannot finde it, but the neerest number in the Table less then it is 65, against which I find 13 *s.* so that 13 *s.* is the greatest fraction part of English Coyn agreeing to this number.

This done, subtract 65 out of 68125000, and there will remain 03125000, which number also you must seek in the Table of English Coyn, but being you cannot find it there, you must take the neerest number lesse then it, which is 02916667, against which I finde 7 pence, which is the next greatest fraction part of English Coyn agreeing to this number.

Again, subtract 02916667, out of 03125000, and there will remain 00208333, which number seek in the Table, and you shall finde it to stand against two farthings, and so much doth this last remainder signifie in English Coyn, and the whole given number 68125000 doth represent in English Coyn 13 shillings, seven pence, two farthings,

farthings, as by the operation following doth appear.

68125000 number given.
65..... the next leſſer number in the Table repreſenting 13 *s.*

03125000 firſt remainer.
02916667 the next leſſer number in the Table repreſenting 7 *d.*

00208333 ſecond remainer, which repreſents two farthings.

So doth the whole number repreſent 13 *s* 7 *d.* 2 *q.*

Example 3.

Let the Decimal 87426934 repreſenting ſome fraction of a pound ſterling be given. If you look in the Table of Engliſh Coyn for 87426934 you cannot finde it; but the neereſt number in the Table leſſe then it is 85, againſt which I finde 17 ſhillings, ſo that 17 ſhillings is the greateſt fraction part of Engliſh Coyn, agreeing to this number.

Then ſubtracting 85 out of 87426934, there will remain 02426934, which number alſo you muſt ſeeke in the Table of Engliſh Coyn, but ſeeing you cannot finde it three, you muſt take the neereſt number leſſe then it, which is 02083333, againſt which I finde five pence, which is the next greateſt fraction part of Engliſh Coyn.

Laſtly, ſubtract 02083333, out of 02426934, and there will remain 00343601, which number you muſt alſo ſeeke in the Table of Engliſh Coyn; but not finding it exactly there, you muſt take the neereſt number leſſe, which is 003125, againſt which you ſhall finde three farthings, which is the next greateſt fraction part of Engliſh Coyn, and the Decimall 87426934 doth in value ſignifie 17 ſhillings, 5 pence, 3 farthings, and ſomething more, for 003125 is the decimall of 3 farthings; and the number you are to look for in the Table is 00343601, greater then the decimall of 3 farthings; wherefore, if you ſubtract 003125 out of 00343601, there will remain 31101, which is the $\frac{31101}{1000000}$ part of a farthing, which is inconſiderable. See the following operation.

87426934 Decimall given.
85 ..... Decimall of ——— 17 *s.*

02426934 Firſt remainer.
02083333 Decimall of ——— 5 *d.*

00343601 Second remainer.
003125.. Decimall of ——— 3 *q.*

00031101 Decimall part of a Farthing.

And here note, that whatſoever hath beene here ſaid concerning the uſes of the Table of Engliſh Coyn, the ſame order is to be obſerved in the uſe of the other Tables of Weight, Meaſure, Time, &c. as by the following Examples (if you make tryall) will appear. *Examples*

Examples.

1 If this decimall 48975694, were given to know the value thereof in Troy weight, you ſhall finde it to containe 15 ounces, 17 peny-weights, and 13 grains.

2 Alſo if 95075335 were a Decimall given, and it were required to finde the value thereof in *Averdupois* great weight, you ſhall finde it to contain 3 quarters of a hundred, 22 pound, 7 ounces, and 2 quarters of an ounce.

3 Likewiſe, if 70800781 were a decimal fraction give, you ſhall finde the value thereof in *Averdupois* little weight to be 11 ounces, 5 drams and one quarter of a dragm.

4 If 4375 were a decimall, whoſe value were required in Liquid Meaſure, you ſhall finde it to contain 3 pints and an halfe.

5 Let 7148438 be a decimall given, whoſe value is required in dry meaſures, you ſhall find it to containe five buſhels, 2 pecks, 3 quarters of a peck, and 2 pints.

Thus have I ſhewed yon the uſe of theſe Decimal Tables in expreſſing of the fraction parts of Money, Weight, Meaſure, &c. But becauſe theſe Tables may not be alwayes at hand when there is need of them, I will here ſhew you how the value of any Decimal given may be known by Multiplication only; and this is

The Rule.

Multiply the Decimal given by the number of known parts of the next inferior Denomination, which are equall to the Integer, the product is the value of the Decimal proposed in that inferiour denomination; and if there happen to be any Decimal in the product, you may in like manner finde the value thereof in the next inferior denomination, and so proceed till you come to the least known parts of the Integer.

Example.

Let .6 7 3 9 5 8 3 4 be a Decimal given, representing the fraction of a pound sterling. First, multiply .6 7 3 9 5 8 3 4 by 20, (the number of shillings in a pound sterling) and the product will be 13 4791 6680, from which cutting off the last eight figures with a dash of the pen (because there were eight figures in the given Fraction) there will stand before the line towards the left hand 13, which are shillings, and the remainder 47916680 standing behind the line, will be the fraction part of one shilling sterling, which number .47916680, you must multiply by 12 (the number of pence in one shilling) and the product will be 575000160, from which number cut off the last eight figures as before, and there will be five left to the left hand, which are five pence, and the figures on the right hand of the line, *viz.* 75000160 are the fraction part of one penny sterling, which therefore multi-

ply

ply by 4 (the number of farthings in one peny) and the product of that multiplication will be 300000640, from which cut off the laſt eight figures to the right hand, and there will be left three towards the left hand, which repreſenteth 3 farthings, and the remaining figures towards the right hand are but the fraction part of a farthing, which we therefore reject. And thus you finde by *Multiplication* onely, that this fraction ·67395834 doth repreſent in the known parts of Engliſh Coyn 13 ſhillings, 5 pence, 3 farthings, as by the following operation appeareth.

	·67395834
	20
Shillings	13|47916680
	12
	95833360
	47916680
Pence	5|75000160
	4
Farthings.	3|00000640

In like manner, if this fraction ·94809028 were given, repreſenting ſome fraction part of Troy weight, you ſhall finde the value thereof to be 11 Ounces, 7 peny weight, 13 grains, as by the operation following appeareth.

	.94809028	
		12
	189618056	
	94809028	
Ounces.	11|377083336	
		20
Peny-weight.	7|54166720	
		24
	216666880	
	108333440	
Grains.	13|000001280	

In this manner may any Decimal given be reduced into the known parts of the Integer by *Multiplication* onely.

¶ Here note, that whereas in the preceding Tables the Decimal fractions consist of seven or eight Figures, we shall in the prosecution of our worke make use onely of four or 5 of the first of them, which will be sufficient in ordinary practice, and come neer enough to the truth in any ordinary question whatsoever.

So if instead of 02916667, which is the fraction part of 7 pence, you take onely 02916, it will be sufficient.

Also

Also for { 0583333 / 0558594 / 583333 } take { 05833 / 0058 / 5833 } { in *Troy w.* / in dry measure. / in Time. }

Thus much concerning the construction and use of the decimal Tables, we shall now come to the practice of *Decimal Arithmeticke*, which shall be taught in the Rule following.

Of Notation of Decimals.

NOtation of Decimals is contrary to that of whole numbers; for whereas in whole numbers their values are increased ten-fold by continuall addition of Figures towards the left hand: so on the contrary the values of the places of Decimals do decrease in the same proportion.

And whereas in whole number, Cyphers in the first place towards the left hand are unnecessary, yet in Decimals they are absolutely necessary to discover the true denominator. Also Cyphers at the end (or towards the right hand) of decimal numbers are of no value, for one single figure in decimals signifies as much as the same figure would doe, if there were Cyphers placed behind it, so 7 is equivolent unto 70, 700, or 7000, &c. For the denominatiors of decimal Fractions are alwayes Cyphers with a unite to-

wards the left hand, as hath been already intimated, So $\frac{70}{100}$ being reduced to its leaſt terms will be $\frac{7}{10}$, and $\frac{7000}{10000}$ will be reduced to $\frac{7}{10}$ alſo, and ſo of any other, as by the Table following doth evidently appear.

9	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
1	0	0	0	0	0	0	0	0	·0	0	0	0	0	0	0	1	
	1	0	0	0	0	0	0	0	·0	0	0	0	0	0	1		
		1	0	0	0	0	0	0	·0	0	0	0	0	1			
			1	0	0	0	0	0	·0	0	0	0	1				
				1	0	0	0	0	·0	0	0	1					
			a thouſand		1	0	0	0	·0	0	1	or $\frac{1}{1000}$					
			a hundred			1	0	0	·0	1	or $\frac{1}{100}$						
			Ten				1	0	·1	or $\frac{1}{10}$							

Addition of Decimals.

IN addition of Decimals, the ſame order is to be obſerved as in addition of numbers of one denomination before taught in the firſt part, in which there is no difficulty: But in decimall numbers the chiefe care to be taken is in placing your whole numbers and fractions in their due order, which you ſhall eaſily and certainly do if you obſerve this generall rule, *viz.* to *place your whole numbers and fractions one under another, ſo that the points of ſeparation which* (in decimal numbers) *diſtinguiſh the whole numbers from the fracti-*

ons

ons, ſtand directly one under the other, then are you to proceed in the addition of them in all reſpects as you did in whole numbers.

Example 1.

Let it be required to add together into one ſum theſe ſeveral ſums following, in a decimal way, *viz.* 36 *li.*--2 *s.*--8 *d.* 29 *li.*--0 --2 *d.* 21 *li.*--16 *s.* 9 *d.* and 6 *li.* 2 *s.* 5 *d.*

Firſt, ſet down 36 *li.* and a point or Comma after it, then for the fraction part of 2 *s.* 8 *d.* look in your Table of Engliſh Coyn, where you ſhall finde the decimal fraction of 2 *ſh.* 8 *d.* to be, 1333 therefore for 36 *li.* 2 *s.* 8 *d.* ſet downe 36.1333.

Secondly, for your 29 *li.* 0 *s.* 2 *d.* ſet downe 29.00831.

Thirdly, for your 31 *li.* 16 *s.* 9 *d.* ſet downe 31.8375.

Laſtly, for your 6 *li.* 2 *s.* 5 *d.* ſet down 6.1208 as you ſee done in the operation following.

	lb	*s.*	*d.*		
	36	2	8		36,1333
For	29	0	2	ſet down	29,0083
	31	16	9		31,8375
	6	2	5		6,1208
	103	2	0		103,0999

Your decimal numbers being thus placed in due order one under another, proceed to the adding of them together, as if they were whole numbers, and you ſhall finde the ſum or totall of them to be 103.0999.

Now

Now the 103 which ſtands towards the left hand are 103 pounds, and the .09999 which ſtands towards the right hand of the Comma, is the fraction part of one pound ſterling, the value whereof you may finde (by the Propoſition before going) to be two ſhillings *ferè*, which ſhould be two ſhillings exact, but it wanteth ſome-what, *viz.* the $\frac{1}{10000}$ part of a farthing, which is inſenſible; for if by the fore-mentioned rule you ſeek the value of the decimal fraction .0999, you ſhall finde it to be 1 ſhilling, 11 pence, 3 farthings, and the $\frac{1}{1000}$ part of a farthing, which you may call in all 2 ſhillings, for decimal numbers will ſeldome happen to give the exact value of fractions, but will be either greater or leſſer then they ought to be; but in ſuch a ſum as this is, the thouſand part of a farthing is not be regarded.

Example 2.

Let it be required to adde together in a decimal way theſe ſums following, *viz.* 29 *li.* 18 *s.* 7 *d.* 3 *q.* 63 *li.* 11 *s.* 2 *d.* 1 *q.* 129 *li.* 4 *s.* 0 *d.* 2 *q.* and 3 *li.* 7 *s.* 10 *d.* 1 *q.*

Firſt, for 29 *li.* 18 *s.* 7 *d.* 3 *q.* ſet downe 29.93229.

Secondly, for 63 *li.* 11 *s.* 2 *d.* 1 *q.* ſet downe 63.55937.

Thirdly, for 129 *li.* 4 *s.* 2 *q.* ſet downe 129.20208.

Laſtly, for 3 *li.* 7 *s.* 10 *d.* 1 *q.* ſet downe 3.39271, as you ſee here downe in the Margent.

Your

Your Decimal numbers thus placed in order, adde them together, as if they were whole numbers, and you ſhall finde the ſum of them to cõtain 226. 08645.

29. 93229	
63. 55937	
129. 20208	
3. 39271	
226. 08645	

Now the 226 which ſtands towards the left hand of the Comma, are 226 pounds, and the other figures towards the right hand, *viz.* .08645 are the fraction of a pound ſterling, which if you reduce by the fore-mentioned Propoſition, you ſhall finde the value thereof to be 1 ſhilling, 8 pence, 3 farthings, ſo the whole ſumme is 226 *li* 1 *s.* 8 *d.* 3 *q.*

And here note, that what hath been ſaid as concerning Money, the ſame is alſo to be underſtood of Weight, Meaſure, Time, &c. as by the following Examples will appear.

Other examples for practice.

Example 1.
In Money.

135. 8833	
95. 5583	
3. 2875	
234. 7291	
234 *li.* 14 *s.* 7 *d.*	

Example 2.
In Troy weight.

7. 97413	
6. 65330	
3. 62187	
18. 24930	
18 *li.* 2 *on.* 19 *p.w.* 20 *gr.*	

Example.

Example 3.	*Example* 4.
In *Averdupois little w.*	In *Averdup. great weight.*
12. 7227	37. 9442
76. 3594	9. 3053
32. 625	33. 6786
91. 4883	10. 0000
32. 8398	12. 8142
246. 0352	103. 7423
246 *li.* 00 *oũ.* 9 *dr.*	103 *C.* 2 *q.* 27 *l.* 3 *oun.*

Subtraction of Decimals.

THe ſubtraction of Decimals differeth nothing from the ſubtracting of one whole number from another, and the decimall numbers to be ſubtracted one from another, muſt be placed in the ſame order as in *Addition* of Decimal numbers, the practice of Subtraction ſhall be ſeen in the following Examples.

Example 1.

Let it be required to ſubtract 31 *li.* 16 *s.* 9 *d.* out of 36 *li.* 2 *s.* 8 *d.*

Firſt, for your 36 *li.* 2 *s.* 8 *d.* ſet down the decimal thereof, which is 36. 1333.

Secondly, for yonr 31 *li.* 16 *s.* 9 *d.* ſet downe the Decimal thereof 31. 8375.

This

This done, draw a line under them, & ſubtracting the leſſer from the greater, you ſhall finde the remainder to be 4. 2958. the 4 on the left ſide of the Comma are four pounds, and the 2958 which ſtandeth towards the right hand, is the fraction part of a pound, the value whereof being ſought, will be found to be 5 *s.* and 11 pence. So that if you ſubtract 31 *li.* 16 *s.* 9 *d.* out of 36 *li.* 2 *s.* 8 *d.* there will remain 4 *li.* 5 *s.* 11 *d.*

36,	1333
31,	8375
4,	2958

But if divers ſums be to be ſubtracted out of one greater ſum, then you muſt firſt adde all the ſeveral ſmaller ſums together, and ſubtract the ſum of them from the greater given ſum, ſo ſhall the reſidue be the ſum deſired.

Examples for practice.

Example 1.

In Money.

Lent	2684.8375
Paid at ſeveral times	36.1333
	29.0083
	31.8375
	6.1208
paid in all	103.0999
reſts to pay	2581.7376
	2581 *li.* 14 *s.* 9 *d.*

Example 2.

In *Averdupois* great weight.

Bought —	103.7423
Sold —	37.9442
Unſold —	65.7981

65 *C.* — 3 *q.* — 5 *l.* 7 *oũ.*

Example 3.

in Troy weight.

Delivered to a Goldſmith of old Plate	7.97413
Received of new Plate	5.59670
Reſts in the Goldſmiths hands	2.37743

2 *li.* 4 *oun.* 10 *p.w.* 14 *gr.*

Multipli-

Multiplication of Decimals.

Multiplication of Decimals differeth nothing at all from the multiplication of whole numbers, for making the greater number the multiplicand, and the leſſer number the multiplyer, the number iſſuing from that multiplication ſhall be called the Product.

Now in the multiplication of Decimal numbers one by another, if there be any fraction either in the multiplicand or multiplyer, or Fractions in both: So many figures as the fractions contain, ſo many figures muſt be cut off from the product towards the right hand, which ſhall be the fraction of the product, and the figures towards the left hand of the Comma in the product ſhall be the integers of the product.

Example 1.

Let it be required to multiply 34 pound, five ſhillings, three pence, by 16 pound, 6 ſhillings, ſix pence.

Firſt, ſeek the decimall of 34 *li.* 5 *s.* 3 *d.* which you ſhall finde to be 34. 2625, make this number

ber your Multiplicand, then ſeek the Decimal of *16 li. 6 s. 6 d.* which you will find to be *16.325*, make this Decimal number your Multiplyer, then draw a line, and multiply theſe two numbers together, as if they were whole numbers, and you ſhall finde the product of them to bee *559.3353125*. Now becauſe there are four figures in the Multiplicand which are fractions, namely, theſe four towards the right hand, *viz.* 2625, and there are alſo three figures in the Multiplyer, which are fractions, namely, theſe three towards the right hand, *viz.* 325, that is in all ſeven figures repreſenting fractions, I therefore cut off from the product the ſeven figures towards the right hand, by making of a comma there to diſtinguiſh the whole number from the fraction: So is 559 the Integer or whole number, and .3353125 the fraction of this Multiplication.

Multiplicand	34.2625
Multiplyer	16.325
	171312 5
	68525 0
	10278 75
	205575 0
	2426 25
Product.	559.3353125

Example 2.

If there be Fractions in the multiplicand, and none in the multiplyer, yet that work is ſtill the ſame, for you muſt cut off onely ſo many figures from the product, as there are fractions either in multiplicand, multiplyer, or both: So if it were required to multiply 5767 yards, and 3 quarters of

of a yard, by 235 yards, you must first set down 5767.75 for your 5767 yards, and three Quarters, which number must be your multiplicand, also set downe 235 yards for your multiplyer, then multiplying them together, as if they were whole numbers, you shall finde the product to be 1355421, 25, and because there are onely two fraction Figures, both which are in the multiplicand, namely, the two last thereof .75, and none in the multiplyer, I therefore cut off onely two figures of the product, namely, the two last, which are .25, so is the product of this multiplication 1355421. 25, which is 1355421 square yards, and one quarter of a yard. And so if a Garden or other piece of land lying square should contain in length 5767 yards, and three quarters, and in breadth 235 yards, the whole piece would contain 1355421 square yards, and one quarter of a yard.

	5767,75
	235
	2883875
	1730325
	1153 55
	1355421.25

Example 3.

If Decimall fractions be to be multiplyed by Decimal fractions, you must then (as before) multiply them as whole numbers, and from the product cut off so many figures towards the right hand, as there are figures in the multiplicand and the multiplyer: So if it were required to multiply .953 by .782 you shall finde their product

product to be .745246, which being but six figures in all, I cut them off, and that fraction .745246 is the product of the multiplication of the two given fractions.

.953
.782
1906
7624
6671
.745246

Example 4.

If any two Decimall fractions being multiplied together, the product thereof doth not consist of so many places as are required (by the former rules) to be cut off, you must then supply that defect by prefixing a Cypher, or Cyphers before the product towards the left hand: So if these Decimal fractions .063 and .0752 were to be multiplyed, their product would be 47376. Now (by the former rules) you should cut off seven figures of the product towards the right hand, but this product 47376 consisteth but of five figures; wherefore to make it seven figures, I prefix two Cyphers before the product on the left hand, making it .0047376, and that is the true product produced by this multiplication.

.0752
.063
2256
4512
.0047376

Example 5.

If you would multiply any Decimall (either fraction onely, or whole number and fraction together) by 10, 100, 1000, &c. You must add so many Cyphers to the multiplicand, as there

are Cyphers in the multiplyer, and cut off so many Figures as there are fractions in the multiplicand, and that number shall be the product required: So if 7,856025 were a Decimal given to be multiplyed by 100, you must (because there are two Cyphers in 100) add two Cyphers to the number given, making it 785602500, then because there were six fraction Figures in the multiplicand, if you cut off the sixe figures of this number towards the right hand, it will be 785,602500, which is the true product required.

Examples for practice.

Example 1.

7,432
2,61

7432
44592
1486 4
19397 52

Example 2.

22,358
32

44716
67074
715.456

Example 3.

.352
.24

1408
704
.08448

Example 4.

375.6218
100

37562.1800

Divi-

Diviſion of Decimals.

AS Diviſion of whole uumbers is the hardeſt of the four Species of Vulgar Arithmetick, ſo the Diviſion of Decimals is the moſt difficult of the four kinds of Decimal Arithmetick, but I hope to make it plain to the underſtanding of the meaneſt capacity.

The ſeveral varieties that may happen in Diviſion, are principally (if not onely theſe) four. Namely, firſt, to divide whole numbers and fractions, by whole numbers and fractions. Secondly, to divide whole numbers by mixt, or mixt numbers by whole. Thirdly, to divide a greater fractions by a leſſe, and laſtly to divide a leſſer fraction by a greater.

In Diviſion of Decimals this rule is general, *If the Dividend be greater than the Diviſor, the quotient will be either a whole number or a mixt, but if the Dividend be leſſe than the Diviſor, the quotient will be a Decimal.* And (for convenience in working, if there be need) any number of Cyphers may be annexed to the Dividend that thereby the quotient may extend to as many places, as the tenour of the queſtion ſhall require.

The manner of the working of Diviſion in Decimals, is the ſame with that before delivered

in whole numbers, as will appear by the Examples following, in every of the four premiſed varieties.

The Rule for the firſt varietie.

The Dividend and the Diviſor, being both mixt numbers, or one of them being a whole number and the other a mixt; or the Dividend being a Decimal, and the Diviſor a whole number or a mixt, the firſt figure in the quotient will be of the ſame place or degree, with that figure or Cypher of the Dividend, which at the firſt demand ſtandeth, or (at leaſt) is ſuppoſed to ſtand directly over the place of Units in the Diviſor.

Example 1. Where the terms given, are both of mixt numbers.

Let it be required to divide 559.3353125 by 16.325. Here the terms given, are both of mixt numbers, which being placed according to the Rules delivered before, for the Diviſion of whole numbers, the figure in the Dividend, which at the firſt demand, ſtandeth over 6, the place of Units in the Diviſor is 5, and becauſe this ſtandeth in the place of tenths, therefore the firſt figure in the quotient is in the place of tenths alſo, and the whole number conſiſteth of two of the foremoſt places, and the reſt is a Decimal, thus the quotient ſought in our preſent example is 34.2625, of which 34 the two firſt figures is the Integer

or

or whole number, 2625 the Decimal fraction.

Diviſor	*Dividend*	*Quotient*
16.325)	559.3353125	(34.2625
	489.75	
	69.585	
	65.300	
	4.2853	
	3.2650	
	1.02031	
	97950	
	040812	
	32650	
	081625	
	81625	

Example 2. One of the terms given, being a whole number the other mixt.

The mixt number 1355421.25 being divided by the whole number 235, the quotient will be 5767.75, and the firſt figure in the place of Thouſands, as by the operation it doth appeare.

Diviſor Dividend

235.) 1355421.25 (5767.75

1175

1804

1645

1592

1410

1821

1645

1762

1645

1175

1175

Example 3. The Dividend being a Decimal, and the Diviſor a whole number.

The Decimal fraction .35673 being divided by the whole number 26, the quotient will be 001372, and the firſt ſignificant figure in the place of thouſands or fourth place from Unitie, as by the operation it doth appear.

Diviſor

```
26).35673(001372
   26
   096
    78
    187
    182
     0053
       52
```

The Rule for the ſecond varietie.

When the Dividend is a whole or mixt number and the Diviſor a Decimal, add as many Cyphers to the Dividend as there are places in the Diviſor for the integral part of the quotient will conſiſt of as many places as the Diviſor, and the places ariſing from the integral part of the Dividend added together.

Example 1.

Let 348.75 be the mixt number given, to be divided by the Decimal .25, to the number given, I add two Cyphers, the number of places in the Diviſor, and then it will be 348.7500, which being divided by .25; the integral part of the quotient will be 1395. becauſe the whole part of the Dividend 348, being divded by .25 giveth two places, and the number of places in the

Diviſor being two, giveth two more; and ſo the Integral part conſiſteth of four figures, as by the operation.

Diviſor *Dividend*

.25) 348. 7500 (1395.

25

98

75

237

225

125

125

Example 2.

Let the mixt number 72.5 be divided by 075, the number of placesin the integral part of this Quotient will be 966. becauſe there are 3 places in the Diviſor; & but 3, becauſe the

Diviſor *Dividend*

075) 72.5000 (966.

675

500

450

500

450

500

450

inte-

integral part of the dividend is leſſe than the ſignificant figures in the Diviſor, as by the operation it doth appear.

The Rule for the third variety.

When the Terms given, are both Decimals the Dividend being the greater the integral part of the quotient will conſiſt of as many places as the Diviſor doth.

Example.

Let the Decimal .73958 be divided by the Decimal .32 the integral part of the quotient will be 23, becauſe the Diviſor doth conſiſt of two places, as by the operation in the margine it doth appear.

Doviſor *Dividend*

.32) .73958 (23,11

64

99

96

35

32

38

32

6

The Rule for the fourth varietie.

When the terms given are both Decimals, conſiſting of

of equal places, the Dividend being the leſſer terme, place the Dividend as a Numerator, and the Diviſor as Denominator; ſo is ſuch vulgar fraction the quotient ſought: But if the terms given conſiſt not of equal places, ſupply the place or places wanting in either of the terms, by annexing a Cypher or Cyphers on the right hand, and then proceed as before. Thus if .27 be given to be divided by .93 he quotient will be $\frac{27}{93}$. Alſo if .35 be given to be divided by .78563, the quotientby annexing 3 Cyphers to .35 the leſſer Decimal given will be $\frac{35000}{78563}$, which vulgar fractions may be reduced into Decimals if need be, by the firſt Propoſition in this Second part of Decimal Arithmetick.

Examples for practice.

44).35673(.0081,&c.

352
47
44
3

.25)2481.00(9924

225
0231
225
60
50
100
100
000

The

The Rule of three in fractions *Vulgar* and *Decimal.*

WHat the Rule of three is, and the manner of working, is already ſhewed in the firſt part, that which we here intend is onely to adde ſome examples in fractions vulgar as well as Decimal; that by comparing the work in both, the excellent uſe of Decimal Arithmetick might the better appear.

And how to convert the known parts of Money, Weight, or Meaſures Engliſh, into Decimals hath been already ſhewed, both Arithmetically and by Tables; yet to prevent the ſeveral additions and ſubtractions in thoſe Tables, we have here annexed another Decimal Table, for the more ſpeedy Reduction of Engliſh money under two ſhillings, all ſummes of money above, not having pence or farthings annexed, being as eaſily reduced by memory as by Tables; and this we have the rather done becauſe the ſame Table, will alſo reduce the Coins of *France*, and the parts of Troy weight, if an ounce be made the Integer, which in point of practice is much more uſefull then the pound.

The

The Table of Reduction.

Penny							
	001042				026014		
	002083	Gr. 1			027083	gr. 13	
	003125				028125		
1	004166	2		7	029166	14	
	005208				030208		
	006250	3			031250	15	
	007291				032291		
2	008333	4		8	033333	16	
	009375				034375		
	010416	5			035416	17	
	011458				036458		
3	012500	6		9	037500	18	
	013541				038541		
	014583	7			039583	19	
	015625				040625		
4	016666	8		10	041666	20	
	017708				042708		
	018750	9			043750	21	
	019791				044791		
5	020833	10		11	045833	22	
	021874				046875		
	022916	11			047916	23	
	023958				048958		
6	025000	12		12	050000	24	

The Table of Reduction.

s. d.								
	051042					076014		
	052083	G 1				077083	13	
	053125					078125		
1 1	054166	2			7	079166	14	
	055208					080208		
	056250	3				081250	15	
	057292					082291		
2	058333	4			8	083333	16	
	059375					084375		
	060416	5				085416	17	
	061458					086458		
3	062500	6			9	087500	18	
	063542					088541		
	064583	7				089583	19	
	065625					090625		
4	066666	8			10	091666	20	
	067708					092708		
	068750	9				093750	21	
	069792					094791		
5	070833	10			11	095833	22	
	071874					096875		
	072916	11				097916	23	
	073958					098958		
6	075000	12			12	100000	24	

Theſe things premiſed; we will now ſhew the uſe of the Table in ſome practical queſtions belonging to the Rule of three direct.

1 *Queſtion.*

If $\frac{7}{8}$ of a yard of cloth, coſt $\frac{9}{13}$ of a pound: what ſhall 17 yards coſt at the ſame rate?

If $\frac{7}{8}$ coſt $\frac{9}{13}$ what ſhall 17 coſt? Anſ. 14 *li.* $\frac{4}{7}$.

Firſt, multiply $\frac{9}{13}$ by $\frac{17}{1}$ the product is $\frac{153}{13}$, then divide $\frac{153}{13}$ by $\frac{7}{8}$, the quotient is $\frac{1224}{84}$: again, if you divide 1224 by 84, the quotient is $14\frac{18}{84}$ or in the leaſt terms 14 pound $\frac{4}{7}$ of a pound.

And the value of this fraction $\frac{4}{7}$ of a pound, will be found by the third rule of Reduction page 107, to be 11 ſhillings, 5 pence, and $\frac{1}{7}$ of a peny, which is ſomewhat above two farthings: for it is 2 farthings, and $\frac{3}{7}$ of a farthing.

The ſame Queſtion in Decimals.

If $\frac{7}{8}$ of a yard of cloth, coſt $\frac{9}{13}$ of a pound, what ſhall 17 yards coſt at the ſame rate?

To anſwer this queſtion $\frac{7}{8}$ of a yard, and $\frac{9}{13}$ of a pound muſt firſt be reduced into Decimals, either by Diviſion, or by the Tables of Reduction; by both which wayes of Reduction the Decimal of $\frac{7}{8}$ will be .875, and the Decimals of $\frac{9}{13}$ will be .75 and then the terms of the queſtion will ſtand thus;

If .875 parts of a yard coſt .75 parts of a pound, what ſhall 17 yards coſt at the ſame rate?

If 0.875 —— 0.75 —— 17. Here if you multiply

tiply the ſecond terme 0,75 by 17 the third term given, the product will be 12.75, and this product divided by .875 gives in the quotient 14.57142, that is 14 pound .57142 parts of a pound, or 145 Decades, that is 14 pound 10 ſhillings, and .7142 parts of a Decade (or two ſhillings) which by the preceding Tables is 1 *s.* 5 *d.* 2 farthings, and .0059 parts of a farthing.

2 *Queſtion.*

If a piece of Gold plate weighing 19 ounces 3 peny weight and 5 grains, be worth 62 pounds, 10 ſhillings, 6 pence, what is one ounce of the ſame gold worth.

This queſtion in vulgar fractions muſt be expreſſed thus.

If 1 *l.* $\frac{3437}{5760}$ Troy weight, coſt 62 *l.* $\frac{126}{240}$, what ſhall $\frac{1}{12}$ of a pound Troy coſt? at the ſame rate.

To anſwer this queſtion the fractions 1 *l.* $\frac{3437}{5760}$, and 62 *l.* $\frac{126}{240}$, muſt be firſt reduced into improper fractions, and the fraction $\frac{1}{12}$ into the leaſt known parts of a pound Troy, and then the queſtion will ſtand thus.

If $\frac{9197}{5760}$ give $\frac{15006}{240}$ what ſhall $\frac{480}{5760}$ give?

Now becauſe it is neceſſary the terms given be reduced into their leaſt Denominations, before the queſtion be reſolved, therefore the anſwer may be found, by uſing the terms given thus reduced, as whole numbers, not having any regard to the Denominators of theſe fractions; Saying thus,

If 9197 grains, coſt 15006 pence, what ſhall 480 grains.

And

And here if you multiply 15006 by 480 the product will be 7202880 which being divided by 9197 the quotient will be 783 pence $\frac{1629}{9197}$ parts of a peny, and divididg 783 by 12 it will be 65 ſhillings 3 pence $\frac{1629}{9197}$, or 3 *l.* 5 *s.* 3 *d.* $\frac{1629}{9197}$. And although this queſtion is thus more eaſily anſwered then it would have been, if the terms had been wrought as vulgar fractious, yet the ſame terms being reduced to Decimals, the anſwer of the queſtion will yet be found with more eaſe, as ſhall appear by the operation following.

The ſame Queſtion in Decimals.

If a piece of gold plate weighing 19 ounces 3 peny weight and 5 grains, be worth 62 l. 10 s. 6 d. what is an ounce of the ſame gold.

The Decimal of 19 ounces 3 peny weight and 5 grains, making an ounce the Integer is by this Table 19.16041, for that 19 ounces are 19 Integers, 2 peny weight is one tenth of an ounce, and the Decimal of one peny weight 5 grains is by this Table 06041; and the Decimal of 62 *l.* 10 *s.* 6 *d.* by the ſame Table is 62.525, and becauſe an Unite or Integer is the third term given, there needs no multiplication, if therefore you divide 62.525 the ſecond term, by 19.16041 the firſt term propounded, the quotient will be 3.26 2 that is 3 pounds, 5 ſhillings, 3 pence, and ſomewhat more, as by the operation in the margine it doth appear.

19.16041

19.16041) 62.52500 (3.2632

57.48123
5.043.770

3.832082
1.211 6880

1.1496246
6206340

5748123
4582170

3832082
750088

If 5 Els and a quarter of linnen cloth, coſt 2*l.* 16*s.* 8*d.* 3*q.* what ſhall 278 els and a halfe coſt at the ſame rate?

If you would work this Queſtion by whole numbers your eaſieſt way is firſt to reduce all the terms into their leaſt Denominations, that is to ſay, the els into quarters, and the pounds, ſhillings, pence, and farthings all intn farthings, ſo ſhall your 5 els and a quarter be 21 quarters, and your 278 els and an halfe will be 1114 quarters, and your 2 *l.* 16*s.* 8*d.* 3*q.* will be 2723 farthings, and then will your queſtion ſtand thus in whole numbers.

quarters *farthings* *quarters*
If 21 — coſt — 2723 — what will — 1114 coſt

Then multiplying the ſecond number by the third, that is, 2723, by 1114, the product will

be 2033422, which divided by 21, the quotient will be 144448 farthings, which being again reduced into pounds, shillings, and pence, giveth 150 *l.* 9 *s.* and 4 pence, as by the operation following doth appear.

The operation.

li.	*s.*	*d.*	*q.*	
5¼ —	2 —	16 —	8 — 3 —	278½
21	20			4
	40			1112
	16	*shillings*		2
	56			1114
	12			
	112			
	56			
	672			
	8	*pence*		
	680			
	4			
	2720			
	3	*farthings*		
	2723			
	1114			
	10892			
	2723			
	2723			
	2723			
	2033422			

```
21) 3033422 (144448
    .......
    ---------
    21
     93
     --
     84
      93
      --
      84
       94
       --
       84
       102
       ---
        84
        182
        ---
        168
         14

                d.
 2              2(4  1     s.  d.
144448 (36112 (300 (9 (150
 44444  12222  222  0
         111
```

But if you would worke the ſame Queſtion by Decimal numbers you may ſave the labour of reducing the terms to their leaſt denominations, for 5 Els and a quarter is in Decimal numbers 5.25, and 278 Els and an halfe is 278.50, and 2 pound 16 *s.* 8 *d.* 3 *q.* is in Decimals 2.8364,

and then your Queſtion in Decimals will ſtand thus.

	Els		*pounds*		*Els*
If	5.25	coſt	2.836	what	278.50

If you multiply (according to the Rule) the ſecond term by the third, that is 2.8364 by 278.50 the product of that multiplication will be 789.937400, which divided by the firſt term 5,25, the Quotient will be 150.4642, which Decimal (by the Example in *page* 177) repreſenteth 150*l.* 9*s.* 4pence, and ſo much in money will 278 Els and an halfe coſt.

The Operation.

Els *pounds* *Els*

5.25 —— 2.8364 —— 278.50

278.50

14182 0

22691 2

19854 8

5672 8

789.937400

5.25(789.937400

```
5.25)789.937400(150.4642
      ......
      ----------------
     525            (150li. 9s. 4d.
     2649
     ----
     2625
       2437
       ----
       2100
        3374
        ----
        3150
         2240
         ----
         2100
          1400
          ----
          1050
           350
```

I have been the larger in this Rule and eſpecially in this Example, which is incumbred with fractions ſufficient, becauſe I would have the Reader the better diſcern the difference between the Vulgar and the Decimal way, and alſo to ſee how expeditious the one is over the other. Now this Example being thus largely explained, I ſhall with the more brevity paſſe over the Rules following, giving one Example, or two at the moſt in each Rule; And thus much ſhall ſuffice for the Golden Rule, or Rule of three direct in Fractions.

An Example in the Rule of Three reverſe.

A *Lends* B 233 *l.* 6 *s.* 8 *d. for a year without intereſt, upon condition that* B *ſhould do the like courteſie for* A *when required.* A *hath occaſion for money* 7 *moneths, how much money ought* B *to lend* A, *to requite his courteſie, and ſave himſelfe harmleſſe?*

I will not in this place tell you what the rule of Three reverſe is, nor the manner of working thereof, that being already ſufficiently declared in the firſt part, but give you the Example, and the working thereof, which take as followeth: So will the Queſtion be thus ſtated.

moneths	*li.*	*s.*	*d.*	*moneths*
12	233	6	8	7

Which in Decimals ſtands thus,

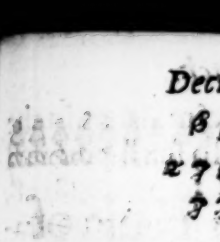
moneths	*li.*	*moneths*
12	233.33	7

12

46666
23333

2799.96

6666(3



Here you ſee that 12 moneths and 7 moneths are whole numbers, and ſo we let them alone without any reduction, but the Decimal of 233 *l.* 6 *s.* 8 *d.* will be found by the fore-mentioned Tables and Rules to be 233.33, which is the middle term in the Queſtion, and of the ſame quality with that, muſt the fourth term ſought be, therefore if (according to the rule delivered in the firſt part) you multiply 233.33 by 12, the product will be 2799.96, which divided by 7 giveth in the Quotient 39999, which is the Decimal of 400 *l.* and ſo much money ought B to lend A for 7 moneths.

Examples in the Rule of Proportion, conſiſting of five numbers.

Queſt. 1.

If 100 *l. in* 12 *moneths, yields* 6 *l. intereſt, what intereſt ſhall* 264 *l.* 16 *s.* 5 *d. yield in* 15 *moneths at the ſame rate?*

Set down your numbers in Decimals, as in the Example following appeareth, ſo ſhall you find the Decimal of 264*l.* 16 *s.* 5 *d.* to be 264.8208, all the reſt being whole numbers having no fractions joyned with them we neglect, and work with them as they are, ſo will the ſeveral numbers of your queſtion (if rightly diſpoſed) ſtand as followeth.

l. *mo.* *l.* *l.* *mon.*

100 — 12 — 6 — 264.8208 — 15

100 6

1200 1588.9248

15

79446240

15889248

1200) 23833.8720 (19.8615

1200

11833

10800

10338

9600

7387

7200

1872

1200

6720

6000

720

or

li. *s.* *d.* *q.*

19 17 2 3

fere

Your

Your numbers being thus orderly disposed, you must (according to the Rule before delivered in the first part, *page* 92) multiply the first and second terms together, which in this Example are 100 and 12, whose product is 1200, which is your Divisor; Then multiply the three last terms one into another, as 264,8208 (which is the decimal of 264 *l.* 16 *s.* 5 *d.*) by 6, and the product thereof will be 1588.9248, which number again multiplied by 15, (which is the last term,) the product will be 23833.8720, which is your Dividend, and this number being divided by your former product, giveth in the Quotient 19.8615, which is the decimal of 19 *l.* 17 *s.* 2 *d.* 3 *q. ferè*, and so much doth the simple interest of 264 *l.* 16 *s.* aud 5 *d.* amount unto in 15 moneths, after the rate of six *per cent.* for a year.

Quest. 2.

If the carriage of 23 *hundred and* 3 *quarters of any thing being carried* 127 *miles, cost* 4 *l.* 13 *s.* 6 *d. what shall the carriage of* 47 *hundred and an halfe of such like commodity cost, being carried* 381 *miles.*

Place your numbers in order as in the following Example doth appear, then multiply the first and second terms together for your Divisor, and the three last one into another for your Dividend, and so will the Quotient of this division answer the Question demanded, and the work will stand as followeth.

C.

```
C.     miles     li.        C.     miles
23.75 — 127 — 4.675 — 47.50 — 381
  12            47.50
 ----          ------
              23375
 4750         32725
2375         18700
-----        ---------
3016.25      222.06250
                   381
             ---------
             22206250
           177650000
           66618750
           ----------
3016.25)84605.81250(28.050
           ..... .....
           ----------
           603250          or
           2428081        28 l.  1 s.
           -------
           2413000
             15081250
             --------
             15081250
             00000.000
```

Here you ſee that the firſt and ſecond terms mul-

multiplied together produced 3016.25, which must be your Diviſor, and the three laſt terms being multiplyed one into another, produce 84605.81250, which number divided by 3016.25, giveth in the quotient 28.050, which decimal repreſenteth 28 *l*, one ſhilling, and ſo much will the carriage of 47 hundred and a halfe coſt, being carried 381 miles?

Thus have I ſhewed the uſe of decimal Arithmetick in ſuch queſtions as concerne the *Golden Rule*, or *Rule of three*; both Direct, Reverſe, and Compounded, by an Example or two in each Rule, and thoſe compounded of fractions ſufficient, I ſhould now proceed to Queſtions in *Fellowſhip*, with and without Time, as alſo to *Barter*, *Alligation*; the Extraction of the Square and Cube Roots, &c. but foraſmuch as theſe laſt mentioned Rules depend one upon the *Rule of Three*, as by the Examples in the firſt part doth plainly appear, I ſhall therefore ſave that labour, and ſpare my Reader the pains of practiſing Queſtions which wholly depend upon that which I (by this time,) ſuppoſe him perfect in; Yet if the Reader be deſirous to make triall of any ſuch Queſtion for his own ſatisfaction, he may either make triall of thoſe Queſtions in the former part of this Book in thoſe ſeveral rules, reducing the numbers there given into Decimals, or if he pleaſe

he

he may frame Queſtions according to his own fancy. And thus I ſhall conclude this ſecond Part.

The end of the ſecond Part.

THE

THE
Third Part,
CONTAINING
INSTRUMENTAL
Arithmetick.

THe Arithmetick, of which we now come to treat, and which I call INSRUMENTAL ARITHMETICK, is not any new kind of Arithmetick, but is indeed the ſame with Decimal Arithmetick before taught; onely, whereas in Decimal Arithmetick, there were certain Tables made of Money, Weight and Meaſure, by help of which the Decimal of any fraction of Money, Weight or meaſure might be ſet down (as it were) in whole numbers, here in this Inſtrumental part, we have contrived certaine

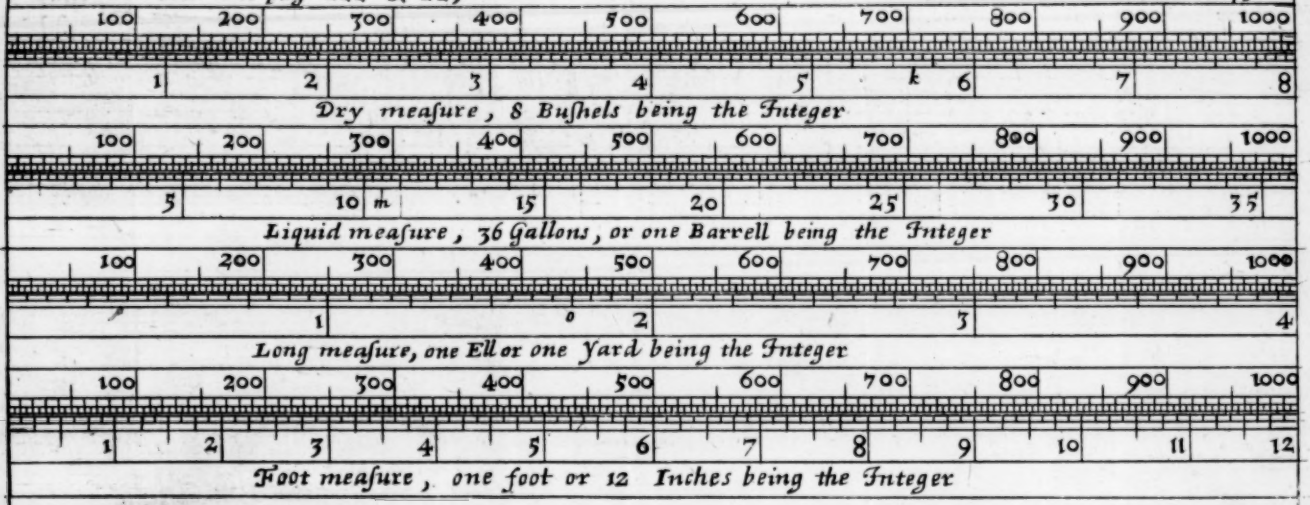
tain Scales of Money, Weight and Measure equally divided into the several denominations into which the several Weights and Measures, can be equally divided, unto every of which Scales there is joyned a Scale of 100, 1000, or 10000, equal parts, according to the length of the Scale, so that by inspection onely you may readily and exactly without addition (as in using the fore-mentioned Tables you must necessarily do) set down the Decimal fraction of any part of Money, Weight or Measure, with great celerity and exactnesse, if the Scale be any thing well divided, though the Scale be but of a reasonable length.

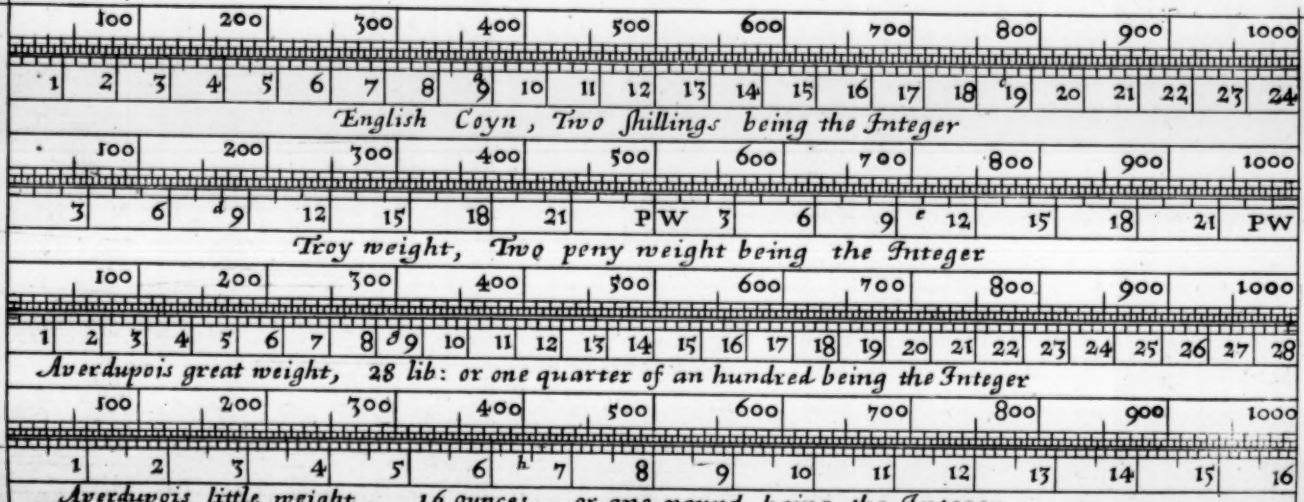
Now the Scales, which I have chiefly made choice of in this Work, as being of most use with English men; (though other Scales may be made for the Coyns, Weights or Measures of any other Countrey as well, and upon the same ground) are chiefly these, *viz.*

1 Of money.
2 Of Troy Weight.
3 Of Avoirdupoise Great weight.
4 Of Avoirdupoise Little weight.
5 Of Liquid measures
6 Of Dry measures.
7 Of Long measures.
8 Of Dozens.

Unto every of these Scales, is joyned another Scale of 100 or 1000 equal parts, these Scales are made to face one another, so that if you look upon any one Division, in the one, you shall

Place this betweene pag 222 & 223 *Deliniavit Antonius Thompson*




100 200 300 400 500 600 700 800 900 1000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
English Coyn, Two shillings being the Integer
100 200 300 400 500 600 700 800 900 1000
3 6 9 12 15 18 21 PW 3 6 9 12 15 18 21 PW
Troy weight, Two peny weight being the Integer
100 200 300 400 500 600 700 800 900 1000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Averdupois great weight, 28 lib: or one quarter of an hundred being the Integer
100 200 300 400 500 600 700 800 900 1000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Averdupois little weight, 16 ounces, or one pound being the Integer

shall also discern plainly what Division or part of a Division answereth thereunto in the other.

These Scales being thus disposed, as they may easily be upon any Ruler of Silver, Brass, or Wood; but best of all upon a Square Ruler, made in form of a Parallelepipedon, will by inspection onely give you any Decimal fraction required without Addition, or (on the contrary) reduce the fraction into the known parts of the Integer, by inspection also, without Subtraction.

Let thus much suffice for a general description of what I mean by Scales, the particular description of them, will more plainly appear, when we treat of Numeration upon the Scales, unto which we shall now proceed. But first take a view of the Scales as they are here disposed, and as they may be set upon such a ruler as I have here mentioned.

Numeration upon the Scales.

THe Scales here to be described are in number eight, as hath been already shewed, and as by the figure of them doth appear.

Now

Now Numeration upon a Scale is to find upon what part of the Scale, any number upon the same Scale will fall.

We will begin with the first, and so proceed till we have given an Example in every one.

1 The first Scale is of English money, and is divided into 24 equal parts, which represent 24 pence or 2 shillings, these parts are numbred with Arithmetical figures, from the beginning thereof, by 1, 2, 3, 4, 5, &c. to 24, each division representing one peny, and the whole 24 divisions representeth 24 pence or 2 shillings, So that where the figure 1 standeth, that part of the Scale representeth one peny, where the figure 2 standeth, it representeth two pence, where the figure 18 standeth, it representeth 18 pence, or one shilling six pence, and so of any other figure of the same Scale.

Then because there are four farthings contained in a peny, each of these pence (or divisions) is sub-divided into 4 other equal parts by short lines, every one of these representing one farthing, so is the whole Scale divided in all into 96 equal parts, which are the number of farthings contained in two shillings. Thus if you look into the Scale of Money for 8 pence 3 farthings, you shall find it at the letter *a*, which letter is here put onely for example sake, Also if you would find in the Scale the place of 18 *d.* halfe peny, you shall find it at *c*, and thus may you find the place of any number of pence and farthings under two shillings upon the Scale.

Unto

Unto this Scale of money (as to all the reſt of the Scales,) there is joyned another Scale, which I ſhall alwayes hereafter call the Scale of 1000, the uſe of which Scale is this. When you have found any number of pence or farthings upon the Scale of money, you ſhall find upon the Scale of 1000, what parts of a thouſand is the Decimal of thoſe pence and farthings: Thus when in the Scale of money you find at the letter *a* 8 pence 3 farthings, if you caſt your eye directly croſſe to the Scale of 1000, you ſhall find 364 to ſtand directly againſt 8 *d.* 3 *q.* which 364 is the Decimal of 8 *d.* 3 *q.* Alſo, if you find upon the Scale of money 18 *d.* halfe penny, which is at the letter *c*, you ſhall find againſt it in the Scale of 1000, this number 771, which is the Decimal of 18 *d.* half penny. And in this manner may the Decimal of any number of pence or farthings under two ſhillings be moſt eaſily and exactly obteined.

Now on the contray, ſuppoſe a Decimal fraction were given, repreſenting ſome part of Engliſh coin, if you look in the Scale of 1000 for your number given, right againſt it in the Scale of money you ſhall find what number of pence and farthings is repreſented thereby. As for Example. Suppoſe .364 were a Decimal given, and it were required to find what part of Coin it doth repreſent. Look in the Scale of 1000 for the number 364, and right againſt it you ſhall find 8 pence, 3 farthings. Alſo if .771 were a Decimal given, if you look in the Scale of 1000 for .771, you ſhall find againſt that

number 771 18 pence 2 farthings. And thus of any other.

By what hath been already ſaid, it may be eaſily diſcerned of what exceeding expedition theſe Scales thus diſpoſed are of, for I dare affirme, that I will ſet down 2 (if not 3) numbers by the Scale, as ſoon as one by the Tables, and if the Scale be but of any reaſonable length, altogether with as much exactneſſe, but if I ſhould vary an unite in the laſt place, in my eſtimation in the Scale of 1000, it is not any thing material.

I have been very tedious in ſhewing the uſe of theſe Scales to find the fraction parts of money, but the reaſon, is becauſe I intend to be the briefer in the reſt, for weight and meaſure, the manner of working (when the diviſion of the Scale is known,) being the ſame in all reſpects without the leaſt alteration.

2 The ſecond Scale is of Troy weight, two Peny weight being the Intiger, which Scale is divided into 48 equal parts or diviſions, each of which diviſions contains one grain, and are numbered by Arithmetical figures at every three grains by 3, 6, 9, 12, &c. to 24, and at the place where 24 ſhould ſtand, there ſtandeth P W, which ſignifieth one peny weight or 24 grains, this P W ſtandeth in the middle of the line. Then is the ſame Scale continued farther by Arithmetical figures 3, 6, 9, 12, &c. as before to 24, and there is written P. W. again, repreſenting two peny weight or 48 grains.

The Scale being thus divided, it is eaſie to find the place where any number of Grains under

der 48 ſhall be upon the Scale, As for example, if it be required to find where 8 peny weight ſhall fall, look upon the Scale of Troy weight from the beginning thereof, and count the figures 3 and 6, then count alſo two of the ſmaller Diviſions, and that makes 8 grains, which you ſhall find to ſtand at the letter *d*, which is the place of 8 grains, Alſo if upon the Scale you would find the place of one Peny Weight 10 grains, you ſhall find it at the letter *e*, and ſo of any other number of grains under 48 or two Peny Weight.

But if you had a Decimal given, and would know what number of grains it repreſenteth, if you ſeek your Decimal given in the Scale of 1000, right againſt it in the Scale of Troy weight you ſhall find the number of grains repreſented thereby.

Example, Let .167 be a Decimal fraction given, If you look in the Scale of 1000, for 167, right againſt it in the Scale of Troy weight, you ſhall find 8 peny weight.

Alſo if .708 were a Decimal given, if you ſeek 708 in the Scale of 1000, right againſt it you ſhall find 1 peny weight 10 grains.

3 The third Scale is of Avoirdupois Great weight, 28 pounds or one quarter of an hundred being the Intiger, this Scale is numbered by 1, 2, 3, 4, &c. to 28, which 28 repreſenteth 28 *l.* or a quarter of a hundred, and each of thoſe is ſubdivided into four other ſmall parts, each repreſenting one quarter of a pound.

Now if you would know what is the Deci-

mal of any number of pounds or quarters under 28, if you seek the number of pounds in the Scale of Avoirdupois great weight, right against it in the Scale of 1000, you shall find the Decimal thereof.

Thus if it were required to find the Decimal of 8 pound and an halfe, if you look upon the Scale for 8 pound and an halfe you shall find it at the letter *g*, and right against it in the Scale of 1000 you shall find 304, which is the Decimal of 8 pounds and an halfe.

On the contrary, supose 304 were a Decimal given, and it were required to find what part of Avoirdupois great weight were represented thereby, if you look in the Scale of 1000 for 304, right against it in the Scale of Avoirdupois great weight, you shall find 8 pound and an halfe.

4 The fourth Scale is of Avoirdupois little Weight, 16 ounces or one pound being the Integer, This Scale is first divided into 16 equal parts, and numbred by 1, 2, 3, 4, &c. to 16, each division representing one ounce. Then againe, each of these ounces, is sub-divided into 8 other smaller parts or divisions, each of which divisions represenleth two drams; but if your Scale be large enough, you may have each ounce divided into 16 equal parts, or divisions, each division representing one dram.

Now to find the Decimal belonginging to any number of ounces and drams, repaire to the Scale of Avoirdupois little weight, and on find the quantity of ounces and drams required,

red, and right againſt it in the Scale of 1000, you ſhall have the Decimal thereof.

Thus if it were required to find the Decimal of 6 ounces and 6 drams, if you look this in the Scale of Avoirdupois little weight, you ſhall find it at the letter *h*, and right againſt it in the Scale of 1000, you ſhall find 398, which is the Decimal of 6 ounces and 6 drams.

But if 398 were a Decimal given, and it were required to find the value thereof in Avoirdupois little weight, if you look for 398 in the Scale of 1000, right againſt it in the other Scale you ſhall find 6 ounces 6 drams.

5 The fifth Scale is of Dry Meaſures, one Quarter or 8 buſhels being the Integer, This Scale is firſt divided into 8 equal parts, and numbred by 1, 2, 3, &c. to 8, each of which diviſions repreſenteth a Buſhel, and each of thoſe parts is again ſubdivided, firſt into 4 equal parts or diviſions, each repreſenting one peck, and then thoſe again ſub-divided into 4 other ſmaller parts, repreſenting qearters, halves, and three quarters of a peck.

Now if you would know the Decimal belonging to any number of Buſhels (under 8 Buſhels or one Quarter) Pecks and parts of a Peck, if you ſeek the number of Buſhels, Pecks, and parts of a Peck in the Scale of Dry Meaſures, right againſt it in the Scale of 1000, you ſhall have the Decimal required.

As for Example, if it were required to find the Decimal belongi ng to 5 Buſhels 2 Pecks and halfe a Peck, if you look into the Scale of dry

Meaſures you ſhall find 5 buſhels 2 pecks and an halfe, to ſtand at the letter *k*, and right againſt it in the Scale of 1000, you ſhall find 702, which is the Decimal anſwering to 5 buſhels, 2 pecks and an halfe.

But if 702 were a Decimal given, and it were required to find what number of buſhels, pecks and parts of a peck it repreſenteth, if you look in the Scale of 1000 for 702, you ſhall find againſt it in the Scale of dry meaſures, 5 buſhels 2 pecks and an halfe.

6 The ſixth Scale is of Liquid Meaſures, the Intiger being 36 gallons or one barrel, this Scale is divided firſt into 36 equal parts or diviſions, and numbered by 5, 10, 15, &c. to 36, then every of theſe diviſions is again ſub-divided into 4 other ſmall diviſions, each repreſenting a quart, but (if the Scale be large enough) you may ſub-divide each gallon into 8 parts, ſo will every part repreſent one pinte.

Now to find the Decimal belonging to any number of gallons (under 36 gallons or one barrel.) quarts or pintes, repaire to the Scale of Liquid meaſures, and ſeek there upon the Scale, the number of gallons, quarts, or pintes, and againſt it in the Scale of 1000, you ſhall find the Decimal thereunto belonging.

So if it were required to find a Decimal repreſenting 10 gallons 2 quarts, or 4 pintes, which is all one, if you ſeek in the Scale of Liquid meaſures for 10 gallons 2 quarts, you ſhall find it at the letter *m*, againſt which in the Scale of 1000, you ſhall find 292, which is the Decimal

Decimal of 10 gallons 4 pintes.

Likewiſe if 292 were a Decimal given, and it were required to find what number of gallons, quarts or pintes were repreſented thereby, if you look in the Scale of 1000 for 292, right againſt it in the Scale of Liquid meaſures, you ſhall find 10 gallons, 2 quarts, or 4 pintes.

7 The ſeventh Scale is of Long Meaſures, the Intiger being Yards or Ells, this Scale is divided into four equal parts and numbered by 1, 2, 3, 4, repreſenting 1 quarter, 2 quarters, 3 quarters or 4 quarters of a Yard or Ell, theſe are again ſub-divided firſt into 4 other equal parts, repreſenting nails, and thoſe may be again ſubdivided at pleaſure if need be.

Now if you would know what Decimal belongeth to any number of quarters or nailes of a yard, if you ſeek the number of quarters and nailes in the Scale of Long meaſure, the Scale of 1000 will give you the Decimal thereof.

Thus if it were required to find the Decimal belonging to one quarter and three nails, if you ſeek this in the Scale of long meaſure, you ſhall find it to ſtand at the letter *o*, againſt which in the Scale of 1000 you ſhall find 437, which is the Decimal anſwering to one quarter and 3 nails of a Yard or Ell.

Alſo if 437 were a decimal given, and it were required to find what quantity of Yards or Ells were repreſented thereby, if you look in the Scale of 1000, for 437, you ſhall in the Scale of long meaſure find againſt it one quarter and 3 nails.

8 The eighth and last Scale is of representative inches, the whole Scale being divided into 12 equal parts and numbered by 1, 2, 3, &c. to 12, and those parts are again sub-divided into halves, quarters, and halfe quarters, as Carpen-Rules are usually divided.

Unto this Scale, (as unto all the other) there is joyned a Scale of 1000, this Scale will readily discover what is the Decimal belonging to any number of Inches; halves or quarters, and the use is the same with the Scales before-mentioned.

Thus have I given you a briefe description of these Scales and the uses of them, and do now suppose my Reader to be perfectly aquainted with the way of numbring or counting upon them, wherefore I intend onely to give you a question or two in the most usual Rules of Arithmetick, any so concluclude; for Decimal Arithmetick being already sufficiently explained, I shall not need to repeat the rules (or the manner of working them) again, but give you one Example, by which the exactnesse and expedition of these Scales may the more evidently appear, for when we work by Scales it is supposed that we do not use Vulgr, but Decimal Arithmetick, and Addition. Subtraction, Multiplication, Division the Rule of Three, and indeed, all the other Rules of Arithmetick are to be performed, as is before taught, the Scales serving onely to avoid Reduction.

Addition.

Addition.

WHat Addition is, and the manner of working of it hath been already taught both in the firſt and ſecond Parts, we will now come to an Example, which let be in Addition of Engliſh Coyn, and let the ſums to be added be 36 *l.* 8 *s.* 8 *d.* 29 *l.* 0 *s.* 2 *d.* 31 *l.* 16 *s.* 9 *d.* and 6 *l.* 2 *s.* 5 *d.*

Firſt, ſet down 36 *l.* 29 *l.* 31 *l.* and 6 *l.* one under another, in ſuch order as you ſee here in the margent, drawing a line by the ſide of them as you ſee here done, and alſo a line under them.

36	
29	
31	
6	

This done, ſeeing that your firſt number to be ſet down to 36 *l.* is 8 *s.* 8 *d.* you muſt for the 8 *s.* (becauſe two ſhillings, which we called a Decade, or the tenth part of a pound is made the Integer, in the Scale of Money) ſet down 4, which is done by memory, and after it make a comma. Then your next number to be ſet by 29 *l.* being 0 *s.* 2. *d.* for the 0 *s.* ſet down a Cypher, thirdly, for your number to be ſet by 31 *l.* being 16 *s.* 9 *d.* for the 16 *s.* ſet down 8 decads, with a comma after

36	4,
29	8,
31	8,
6	1,

after it, and laſtly, the number to be ſet by 6 *l.* being 2 *s.* 5 *d.* for the 2 *s.* I ſet down 1 decade with a comma after it, and then will your work ſtand, as here you ſee.

Then take your Scale in hand, and ſeeing your firſt number of pence are 8 *d.* look in your Scale of Money for 8 *d.* and againſt it in the Scale of 1000, you ſhall find 333, which ſet to 36 *l.* 8 *s.* behind the comma, then your next number of pence being 2 *d.* look in your Scale for 2 *d* and againſt it in the Scale of 1000, you ſhall find 083, which ſet to 29 *l.* 0 *s.* behind the comma. Then your third number of pence being 9 *d.* look in your Scale for 9 *d.* and againſt it in the Scale of 1000, you ſhall fiud 376, which ſet to 31 *l.* 16 *s.* and laſtly, your laſt number of pence being 5 *d.* look in your Scale for 5 *d.* and againſt it you ſhall find 208, which ſet to 6 *l.* 2 *s.* and then will your whole work ſtand, as here you ſee.

36	4,333
29	0,083
31	8,376
6	1,208
—	———

Your ſums being thus ſet down, which is done with more facility then you can imagine, till you make trial and be ſomething perfect therein, you muſt then adde all the numbers together as in Addition of Decimals, and you ſhall find the ſum of them to be 103|4,000, Now to know what this is in money is as eaſie as it was to ſet the ſeveral ſums down, for the figures 103, which ſtand behind the down right line, are 103 *l.* and the figure 4 which

ſtands

ſtands between the down right line and the comma, are 4 decades or 8 *s.* and being the reſt to the right hand are all Cyphers, they ſignifie neither pence nor farthings, ſo is the total of this addition 103 *l.* 8 *s.* 0 *d.*

l.	
36	4, 333
29	0, 083
31	8, 376
6	1, 208
103	4, 000

That the manner of working may appeare more plain, I will give you another ſhort Example as difficult as I can invent, which I performed by a Scale of Wood but of 8 inches long. Let the ſums to be added together, be theſe following.

li.	*s.*	*d.*	*q.*
332 —	17 —	4 —	1
159 —	6 —	8 —	1
217 —	5 —	3 —	3
709 —	9 —	4 —	1

Firſt, ſet down your ſeveral ſums of pounds one under another as before, and draw a line by the ſide of them, and another under them. So will they ſtand as here you ſee.

332
159
217

1 Your ſums of pounds being thus orderly placed and lines drawn, repair to your Scale, and ſeeing your firſt number of ſhillings, pence and farthings is 17 *s.* 4 *d.* 1 *q.* for your 17 *s.* ſet down

down 8 decads, which is 16 *s.* with a comma after it, then will there reſt to be ſet down 1 *s.* 4 *d.* 1 *q.* or 16 *d.* 1 *q.* which if you ſeek in your Scale of Money, you ſhall find to ſtand againſt it in the Scale of 1000 this number 677, which is the Decimal of 1 *s.* 4 *d.* 1 *q.*

2 Your ſecond number of ſhillings pence and farthings is 6 *s.* 8 *d.* 1 *q.* for your 6 *s.* ſet down 3 decads, which is 6 *s.* and then there will remaine 8 *d.* 1 *q.* which if you ſeek in your Scale of money, you ſhall find to ſtand againſt it in the Scale of 1000 this number 344, which is the decimal of 8 *d.* 1. *q.*

3 Your third number of ſhillings pence and farthings is 5 *s.* 3 *d.* 3 *q.* for your 5 *s.* ſet down 2 decads, which is 4 *s.* with a comma after it, then will there reſt to be ſet down 1 *s.* 3 *d.* 3 *q.* or 15 *d.* 3 *q.* which if you ſeek in your Scale of Money, you ſhall find to ſtand againſt it in the Scale of 1000, this number 656, which is the Decimal of 15 *d.* 3 *q.* or 1 *s.* 3 *d.* 3 *q.* and the three ſums to be added together will ſtand as here you ſee.

l.	
332	8,677
159	3,344
217	2,656
709	4,677

Theſe ſums being added together, according to the rule for Addition of Decimals, you ſhall find the ſum of them to be 709,4677, now to know what this is in Money, take notice that the 709 which ſtands to the left hand of the down right line are 709 pounds, and the figure 4 which ſtands between the down right line and the

the comma, are 4 decads or 8 *s*, but (becauſe the firſt figure next after the comma is above 5, *viz.* 6) you muſt add 1 *s.* to the 4 decads, making them 9 *s*; then will there remain 177, wherefore if you look in the Scale of 1000 for 177, you ſhall find againſt it in the Scale of Money 4 *d.* 1 *q.* So is the whole ſum of this Addition 709 *li.* 9 *s.* 4 *d.* 1 *q.* as by the preceding work doth appear.

¶ Here note, that when you had ſet down your 709 *li.* 4 decads or 8 *s.* there remained beyond the Comma 677, which if you had ſought in your Scale of 1000, you ſhould have found againſt it in the Scale of Money 15 *d.* 1 *q.* or 1 *s.* 4 *d.* 1 *q.* (which is all one) as before, for it appeareth plainly by the Scale that 500 in the line of 1000 is equal to one ſhilling.

I might proceed farther in giving you Examples in Weight and Meaſure anſwerable to the Scales, but that would only make the Reader ſpend his time to little purpoſe, for being before acquainted with Decimal Arithmetick, and (as by this time I ſuppoſe he is) with Numeration upon the Scales, he cannot be deficient in the applying of the other Scales of Weight and Meaſure to the ſame purpoſe for which they were contrived, I having ſo largely exemplified the uſe of the Scale of Money.

Sub-

Subtraction.

Subtraction (as hath been before ſaid) is the taking one or more ſmaller ſums out of one greater, I ſhall onely give you an Example or two, as I have taken the numbers from a Scale.

Example.

Delivered to a Goldſmith of old plate 297 ounces, 13 penny wight, 19 grains.

Received of the ſame Goldſmith firſt 165 ounces, 11 penny weight and 7 grains, and after that received of the ſame Goldſmith 32 ounces 19 penny weight, and 23 grains, what plate remains in the Goldſmiths hands?

Take your numbers out of the Scale of Troy weight, and ſet them down, as here you ſee.

	ounces	
Delivered	297	6,896
Received firſt	165	5,646
Received more	32	9,979
Received in all	198	5,625
Reſts in the Goldſmiths hands	99	1,271

or

ounces	*peny w.*	*gr.*
99	2	13

Then

Then adde the ſeveral weights of plate received, together, and they make 198 5,625, or 198 ounces, 11 peny weight, 6 grains, which if you ſubtract from 297 6,896, or 297 ounces, 13 peny weight 19 grains, which was the quantity of plate delivered, there will remaine 99 1,271, or 99 ounces 2 peny weight, 13 grains, and ſo much plate is ſtill in the Goldſmiths hands. And let thus much ſuffice for Subtraction.

Now we ſhould proceed to Multiplication and Diviſion, but being when the numbers are taken from the Scale and ſet down, the manner of working doth not at all differ from Multiplication and Diviſion of Decimals before taught. But that we are now a treating of Inſtrumental Arithmetick (becauſe I will not alter the method before uſed, in the firſt and ſecond parts of this Book;) I will therefore here ſhew you how Multiplication and Diviſion, may be Inſtrumentally performed by *Nepers* Bones.

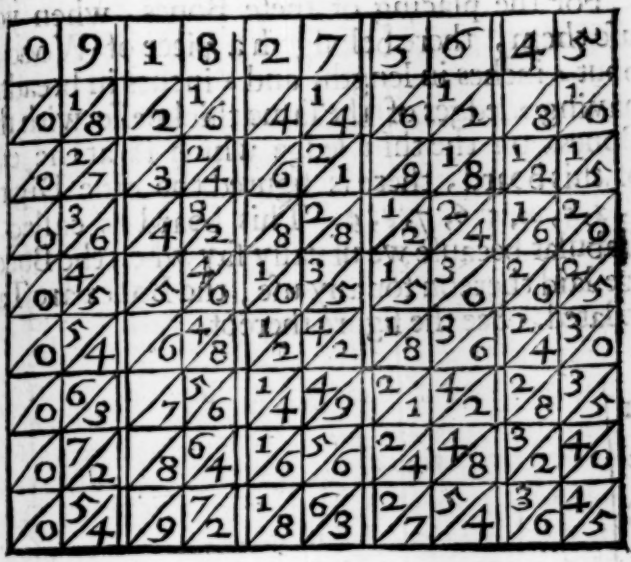
Multipli-

Multiplication by *Nepers* Bones.

MUltiplication and Division are accounted the hardest parts of Vulgar Arithmetick; but by the invention of the Right Honorable *John* Lord *Neper* Baron of *Merchiston*, they are both of them made very easie, and more certaine then in the ordinary way, the memory not being charged at all, but as in Addition and Subtraction, what this Artifice is, is shewed by himself in his treatise of *Rabdologia*, as also in that of Mr. *Seth Partridge* and others, and therefore it will not be necessary to make any large discourse of it now, it will be sufficient here, onely to give you a description of them, and how to use them.

These Rods or Bones are nothing else, but the ordinary Multiplication Table, commonly called *Pythagoras* his Table, cut into pieces with Diagonal lines between the figures of every product in single multiplication; as by the figure following it doth appear.

A Figure of the Bones.



The Bones are uſually made of ſmall pieces of Box, containing in length about 1 inch and $\frac{1}{10}$ of an inch, and in breadth about $\frac{1}{10}$ of an inch, and in thickneſſe neer $\frac{1}{10}$ of an inch. One ſet of theſe Bones conſiſteth of 5 pieces of Box, and are graduated with Diagonal lines and figures, as you ſee here in the figure of them. On one of the 5 pieces there is 0 and 9, the 0 being on one ſide of the Wood, and the 9 on the other ſide, another hath 1 and 8, the third 2 and 7, the fourth 3 and 6, and the fifth 4 and

5. Now these five pieces of Box contain one Table of Mutiplication cut in pieces, but so few are not sufficient for use, for you cannot well have lesse then six sets of them, that is 30 pieces, and so many are usually made.

For the placing of these Bones, when you use them, there belongeth a piece of Wood about 4 inches in length, and 2 inches in breadth, having 2 ledges of the same thickness with the Bones, on the thin ledge which is at the end of this board, there is figured the nine Digits, 1, 2, 3, 4, 5, 6, 7, 8, 9. This board is called a Tabulat, because we usually say when the Bones are laid thereon for any use, the Bones are Tabulated. See the figure thereof.

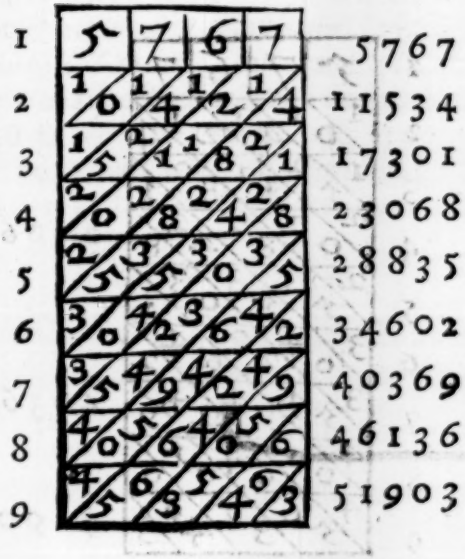
Now

Now theſe Bones thus ordered and tabulated doth not onely give you the product of every ſingle Digit, multiplied by it ſelf, or any one of the Digits, but the ſeveral products of all the 9 Digits together by every of the 9 Digits, as if it were demanded how much 123456789 will amount unto, being multiplied by 6, in this Table it will be found to be 740740734, for the product of 9 multiplyed by 6 is 54, the firſt figure whereof towards the right hand, *viz.* 4, is placed under the Diagonal line, and 5 being in the place of tens is placed above it, againe 8 multiplied by 6 is 48, the firſt figure whereof towards the right hand, *viz.* 8 is placed under the Diagonal line as in the other product, and theſe 2 figures 5 in the upper part of the former product, and 8 in the lower part of this muſt be added together, and being ſo they make 13, therefore next unto 4 in the firſt product, I ſet down 3, and carry 1 to 4 the figure placed above the Diagonal in this ſecond product, which together with the lower figure in the next product, *viz.* 2, do make 7, for 4 and 1 that I carrid is 5, and 2 the figure under the Diagonal in the next product are 7, and ſo the 3 firſt figures of this product towards the right hand are 734, in like manner muſt the figures remaining between the Diagonals be added together, and their ſum if it amount not to ten muſt be ſet down in his proper place, but if they make or exceed ten, ſet down the overplus, and carry the ten in mind to the next figures between

the Diagonals as in the last product; So likewise in that which followes 4 and 6 the figures between the Diagonals being ten, I set down a Cypher, and carry one to the next figures, which are 3 and 0, now 3 and 1 that I carried is 4, and 4 and 0 is 4 still, and therefore next to the Cypher I set down 4 in the paper; the figures in the next Diagonal are 3 and 4, that is 7, wherefore I set down 7 in the paper, the next are 2 and 8 that is 10, therefore I set down 0 in the paper and carry 1, the next are 1 and 2 which with 1 that I carried make 4, therefore I set down 4 in the paper, the last are 1 and 6 which make 7 and so at last the whole product of 123456789 multiplied by 6 is 740740734.

Now as the multiplication Table thus ordered doth give the product of all the 9 digits placed orderly by every of the 9 digits, so being cut in pieces or slips, and having many of them made in Past-board or Wood, any other sum may be placed on the Tabulat, and the several products thereof by every of the 9 digits will be found in the like manner; thus if it were required to multiply this number 5767 by every of the 9 digits, placing the slips with these figures on the top orderly, as they are in the same, the product of 5767 by 3 will be found to be 17301, the product thereof by 8 is 46136, and so for any other as in the annexed Scheame.

Also



Alſo if it were required to multiply 5767 by 749, the product of 5767 by 9 is 51903, and the product thereof by 4 is 23068, and the product by 7 is 40369, and theſe products being ſet down and added together, as in ordinary Multiplication, the product of 5767 multiplied by 749 will be 4319483, as by the operation in the margine it doth appear.

```
  5767
   749
 -----
 51903
 23068
40369
 -----
4319483
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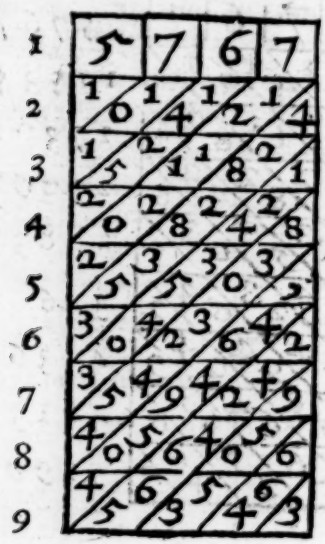

Of Division by the Rods.

LEt it be required to divide 4319483 by 5767, placing this Divisor on the Tabulat, as was directed for Multiplication, the products of your Divisor by every of the 9 Digits is given you, and may be deducted from the Dividend, as hath been already shewed *pag.* 55, and according to the rules there delivered, I ask how often is 5767 in 43194, and the answer by my Table is 7 times, and therefore

I

I ſubtract 40369 the product of 5767 by 7 from 43194, and there reſts 2825, which with the next figure in the Dividend, *viz.* 8, is 28258, in which I find 5767 to be contained 4 times, and therefore I ſubtract 23068 the product of 5767 by 4 from 28258, and there reſts 5190, which with the next figure in the Dividend, *vix.* 3, is 51903, in which I find 5767 to be contained 9

	Dividend	*Quotient*
Diviſor 5767.)	43194 83	(749
	40369	*Subt.*
	28258	*Remaine*
	23068	*Subt.*
	51903	*Remaine*
	51903	*Subt.*
	00000	*Remaine*

times, and therefore I ſubtract 51903 the product of 5767 by 9, from 51903 the remaining figures of the Dividend, and there reſteth nothing, and therefore the quotient is 749, as by the operation it doth appear.

And thus may you doe with any other ſum (having a competent number of Bones or Rods ready for the work) without any charge to the memory, which in other wayes cannot be avoided, and by reaſon of which many miſtakes may happen, which are in this prevented. Alſo by the Bones there is this commodity,

that when it is doubtfull what figure to set in the Quotient, the Bones will certainly direct you, so that you cannot possibly mistake.

These Rods or Bones (as they are commonly called) are of excellent use in extracting the Square and Cube Roots, but that being already taught in the first Part, I shall not here insert it again, for he that can extract the Square and Cube Roots any way, cannot be ignorant to effect the same by the Bones, if he can multiply and divide by them.

Having done with the four Species of Arithmetick in this Instrumental way, I should now proceed to the Golden Rule of three, and consequently to the other Rules of Arithmetick, but having in the former Parts of this Book performed that already both in whole numbers, Fractions, and Decimals, I shall onely give you an Example in the most necessary Rules, and so conclude.

Exam-

Example in the Rule of Three Direct.

IF 37 Ells and a halfe of linnen cloth, coſt 24 li. 7 s. 9 d. what ſhall 183 Ells and an halfe coſt?

Firſt, ſet down your 37 Ells, then if you look in your Scale for your halfe Ell, you ſhall find it to ſtand againſt 500 in the Scale of 1000, which 500 may be called 5 onely, for the two Cyphers may be omitted. Then ſet down your 24 *l.* and for your 7 *s.* ſet down 3 decads, which is 6 *s.* and look in your Scale for the Decimal of 1 *s.* 9 *d.*, which you ſhall find to be 875; Laſtly, ſet down your 183 Ells, and for your half Ell ſet down 5 as before, ſo will your numbers ſtand thus,

Ells		*li.*		*Ells*
If 37.5	*coſt*	24.3 8 7 5	*what*	183.5
		1 8 3 5		
		1 2 1 9 3 7 5		
		7 3 1 6 2 5		
		1 9 5 1 0 0 0		
		2 4 3 8 7 5		
		4 4 7 5 1 0 6 2 5		37.5

37·5)4475.10625(119.3361
or
375 (119 *li.* 6*s.* 8*d.* 2 *q.* $\frac{210}{1000}$
725
375
511
3375
1260
1125
1356
1125
2312
2250
625
375
250

Your numbers thus taken out of your Scale and placed as here you see, if you multiply the second and third together, you shall find the product of that multiplication to be 4475,10625, which divided by the first number 37,5, giveth in the Quotient 119,3361, which is 119 pounds,

3

3 decads, or 6 ſhillings, and 361, which reduced by the Scale giveth 8 pence 2 farthings, and ſomething more.

Example in the Rule of Three Reverſe.

IF when the price of the Quarter of Wheat is 1 *li.* 5 *s.* 6 *d. the penny white loafe ſhall weigh* 12 *ounces* 16 *peny weight, I demand what the penny white loaf ſhall weigh, when the price of the Quarter of Wheat is* 7 *s.* 6 *d?*

If you place your numbers according to the tenor of the Queſtion, they will ſtand as followeth.

li.	*s.*	*d.*		*ou.*	*pw.*		*s.*	*d.*
1	5	6	—	12	16	—	7	6

But being taken out of the Scales of Money and Troy Weight, they will ſtand thus,

1,275 *li.*

```
   li.          ounces          s.
 1.275 ——— 12.8 ——— .375
   12.8
 ------
 10200          .375) 16.3200(43.5
  2550                 ...
 1275                 ------ or
 ------               1500  ounces pw.
 16.3200               1320  43 — 10 75/100
                      ------
                       1125
                        1950
                       ------
                        1875
                          75
```

Here if you multiply 1.275 which is the Decimal of 1 *l.* 5 *s.* 6 *d*, by 12.8, which is the Decimal of 12 ounces 16 penny weight, you shall find the product of that multiplication to be 16.3200, which being divided by .375, which is the Decimal of 7 *s.* 6 *d*, the Quotient will be 43.5, which is the Decimal of 43 ounces, 10 penny weight 3 grains, and so much ought the penny white loafe to weigh, when the quarter of Wheat is sold for 7 *s.* 6 *d.*

Example

Example in the Double Rule of Three.

IF 24 yards of stuffe of three quarters broad cost 4 li. 14 s. what shall 328 yards of the same stuff cost being 5 quarters broad.

If you place your numbers according to the directions of this Rule, they will stand thus,

	yards	*quarters*	*li. s.*		*yards*	*q.*
If	24	of 3	cost 4	14 what	shall 328	cost of 5

But if you take your fraction numbers out of their proper Scales, they will stand thus,

yards	*quarters*	*li.*	*yards*	*quarters*
24	— 3 —	4·7	— 328	— 5
3			4·7	
72			2296	
			1312	
			15416	
			5	
			7708.00	

72)

```
72) 7708.000 ( 107.055
    ------
     72                 or
      508        li.   s.   d.
     ----        107 — 1 — 1
      504
       400
      ----
       360
        400
      ----
        360
         40
```

First, multiply the two first numbers, as 24 and 3 together, they make 72 for Divisor, then multiply 4.7, which is the Decimal of 4 *l.* 14 *s.* by 328, and the product is 15416, which again multiplied by 5 the last number, giveth 77080, unto this product, (that there may be a competent number of figures in the quotient,) I add two Cyphers, making it 7708000, which I divide by 72, and the quotient is 107.055, which is 107 *l.* 1 *s.* 1 *d.* and so much is 328 yards of stuffe worth, being 5 quarters broad.

Example

Example in Barter.

TWo Merchants having two ſeveral commodities are willing to barter or exchange the one with the the other. The one hath Indigo which he will ſell at 4 s. the pound, for ready money, but in Barter he will have 4 s. 9 d. the ponnd, the other Merchat hath Kerſies, which for ready money he will ſell for 3 s. 6 d. the yard. Now the Queſtion is at what price he muſt rate his Kerſies in Barter to equallize the 9 d. advance upon the pound of Indigo.

The tenor of the Queſtion is this,

If 4 s. in Barter require 9 d. what ſhall 3 s. 6 d. require?

Your numbers placed will ſtand thus,

s.	*d.*	*s. d.*
4	9	3 6

But being taken out of your Scale they will ſtand thus,

Decad,

Decads	*d.*	*s.*
2	.375	1.75

1.75

1875
2625
375

2) .656|25(.328
. . . . .

65
4

16

Say then by the Rule of three Direct, if 2 decads or 4 *s.* in Barter require .375, which is the Decimal of 9 *d.* what shall 1.75 require? which is the Decimal of 3 *s.* 6 *d.*

First, multiply .375 by 1.75, the product is .65625, (but being it is a fraction I cut off the two last figures because we require onely three figures in the Quotient, which divided by 2 giveth in the Quotient .328, which is the Decimal of 7 *d.* 3 *q.* this 7 *d.* 3 *q.* added to his 3 *s.* 6 *d.* maketh 4 shillings 1 penny 3 farthings, and so much ought he to rate his Kersies at by the yard in Barter to save himselfe harmlesse.

Example

Example in Fellowſhip.

THree perſons A, B, *and* C *bought* 4000 *ſheep, which coſt* 483 *li.* 6 *s.* 8 *d. of which money* A *paid* 203 *l.* B *paid* 165 *li.* 15 *s.* 8 *d. and* C *paid* 114 *l.* 11 *s.*

Firſt ſay by the Rule of three Direct,

1 If 483 *l.* 6 *s.* 8 *d.* buy 4000 ſheep, how many ſheep ſhall 203 *l.* (which is A ſhare) buy? *Anſwer* 1680.

2 Say, if 483 *l.* 6 *s.* 8 *d.* buy 400 ſheep, how many ſheep ſhall 165 *li.* 15 *s.* 8 *d.* (which is B ſhare) buy? *Anſwer* 1372.

3 Say again, if 483 *l.* 6 *s.* 8 *d.* buy 4000 ſheep how many ſheep ſhall 114 *l.* 11 *s.* (which is B ſhare) buy? *Anſwer* 948.

Your numbers being taken out of your Scale, proceed as followeth.

First for A.

li.		*sheep*		*li.*
If 483.3333	*buy*	4000	*what*	203

4000

812000

483.3333) 8120000000 (1680

....

4833333

32866670

28999998

38666720

38666664

00000560

Secondly for B.

li.		*sheep*		*li.*
483.3333	——	4000	——	165.7833

4000

663133200

483.3333

```
483.3333)6631332000(1372
                 ....
          ----------
          4833333
          17979990
          ----------
          14499999
           34800010
          ----------
           33833331
             9666790
          ----------
             9666666
                  124
```

Thirdly for C.

li.		*sheep*		*li.*
483.3333	——	4000	——	114.55
				4000
				458200.00

```
483.3333)4582000000(948
                 ...
          ----------
          43499997
           23200030
          ----------
           19333332
            38666980
          ----------
            38666664
                 316
```

The manner of work.

1 For A multiply 203 *l.* (which was A ſhare) by 4000, (which is the number of ſheep bought,) and the product is 812000, which numbe ſhould be divided by 483.3333, but being it i greater then 812000, I therefore adde four Cy phers thereto, that I may have four figures i the quotient, and it makes 8120000000, whic divided by 48[illegible].3333, giveth in the quotien 1680, and ſo many ſheep belong to A.

2 For B, multiply 165.7833 (which is the De cimal of B ſhare) by 4000, (the number of ſhee bought) and it produceth 663133 2000, whic divided by 483.3333, giveth in the quotien 1372, and ſo many ſheep belong to B.

3 For C, multiply 114.55, (which is the De cimal of C ſhare,) by 4000, (the number ſheep bought,) it produceth 45820000, whic number ſhould be divided by 483.3333, b being it is not large enough to give figures nough in the quotient, I therefore adde tw Cyphers making it 458 2000000, which divide by 48[illegible].3333, giveth in the quotient 948, an ſo many ſheep ought C to have.

Now for proof, if you add the number of ſheep that A, B and C ſhould ſeverally have, you ſhal find them in all to make 4000, which demonſtrates the work to be true.

A	1680
B	1372
C	948
	4000

Exa

Examples in Losse and Gain.

If one yard of Stuffe cost 6 s. 8 d. and I sell the same again for 8 s. 6 d. what shall I gain in laying out 100 l. upon such commodity?

Take the difference between the price that your commodity cost, and the price for which you sell it, that is, in this Example, the difference between *6 s.* 8 *d.* and *8 s. 6 d.* which is 1 *s.* 10 *d*, then say by the Rule of Three Direct,

If *6 s.* 8 *d.* gain 1 *s.* 10 *d.* what will 100 *li.* gain?

If you place yonr numbers according to the Rule of Three Direct, as they are here given, they will stand thus,

s.	*d.*		*s.*	*d.*		*li.*
6	8	——	1	10	——	100

But being taken out of your Scale and placed, they will stand as followeth.

s. *s.* *li.*

,3333 ——— ,425 ——— 100

100

.3333)42500|00(127.5

3333

9170

6666

25040

23331

17090

16665

425

Your numbers being placed, multiply 425 which is the decimall of 1 *s.* 10 *d.* by 100 *li.* and the Product is 42500, to which I add two Cyphers (that I may have a competent number of figures in the quotient) and it makes 42500 00, which divided by .3333 the decimall of 6 *s.* 8 *d.* giveth in the quotient 127.5, which is 127 *li.* 5 livers or 10 *s.* so there is 27 *li.* 10 *s.* gained in laying out of 100 *l.*

I will here prove this Question by the converse.

If one yard of Stuffe which is sold for 8 *s.* 6 *d.* there

there was gained 27 *li.* 10 *s.* in laying out of 100 *li.* I demand what the said stuffe cost a yard at the first hand?

Adde 100 *li.* and 27 *li.* 10 *s.* together, and they make 127 *li.* 10 *s.* Then say by the Rule of Three Direct,

If 127 *l.* 10 *s.* give 100 *l.* what shall 8 *s.* 6 *d.* give?

Take your numbers out of your Scale and place them as here you see.

li. *li.* *s.*
If 127.5 give 100 what .425

127.5) 42500|0(3333

3825
4250
3825
4250

Here if you multiply 425, which is the Decimal of 8 *s.* 6 *d.* by 100, you shall have 42500, to which if you adde a Cypher, you make it 425000, this number being divided by 127.5, which is the Decimal of 127 *l.* 10 *s.*, giveth in the quotient 3333, and if you had added more Cyphers to the Dividend, you should have had

more threes in the quotient, and no other figures, but these four threes are enough, and are a decimal fraction representing 6 *s.* 8 *d.* and so much did the yard of Stuffe cost at the first hand.

Examples in Losse and Gain upon Time wrought by the Double Rule of Three.

IF one Ell of Lockeram, cost me 2 *s.* 8 *d. ready money, and I sell the same again for* 2 *s.* 10 *d. the Ell to be paid at the expiration of three moneths, I demand what I shall gain in* 12 *moneths, laying out* 100 *l. upon that commodity.*

This and such like Questions, although they may be wrought by the Rule of three Direct, at two operations, yet they are best performed by the Double Rule of three compounded of five numbers, wherefore the Question may be thus stated.

If 2 *s.* 8 *d.* in three moneths, gain 2 *d.* what shall 100 *li.* gain in 11 moneths?

If

If you take your numbers out of your Scale, and place them according as was directed in the first part of this Book, you you shall find them to stand thus,

s. *mo.* *d.* *li.* *mon.*
If 1.333 *in* 3 *gain* .83 *what shall* 100 *gain in* 12

3 — 100

3999 — 8300

12

16600

8300

3999) 99600 (25 *ferè*

7998

19620

19995

375

Your numbers being placed according to the tenor of the Question, if you multiply 1.333, which is the Decimal of 2 *s.* 8 *d.* by 3 moneths, the product will be 3999, which must be your Divisor, then multiply .83 which is the Decimal of 2 *d.* by 100 *l.* and it makes 8300, that again

again multiplied by 12 moneths, giveth for the product 99600 for your Dividend, wherefore if you divide 99600 by 3999, it will give you in the quotient 25 almoſt, which is 25 *li.* for the Decimal fraction remaining is ſo ſmall that it wanteth not neer a farthing of 25 *li*, and therefore we call it 25 *li*, & ſo it is exactly, as you may trie, if you reduce all the numbers to their leaſt denominations, and work as is before taught in *Vulgar Arithmetick.*

I will prove this Queſtion by the converſe.

If one Ell of Lockeram coſt me 2 *s.* 8 *d. ready money, for what price ſhall I ſell the ſame again to be paid at the end of three moneths. So that I may gain* 25 *li. in* 100 *li. for* 12 *moneths?*

Say by the Rule of Three Direct,

If 100 *li. in* 12 *moneths gain* 25 *li. what ſhall* 2 *s.* 8 *d. gain in* 3 *moneths?*

If you take your numbers out of your Scale and place them according to the Double Rule of Three, they will ſtand as followeth.

li.

li.	*m.*	*li.*	*s.*	*mon.*
100	— 12 —	25	— 1.333 —	3
12			25	
200			6665	
100			2666	
1200			33325	
			3	
			99975	

1200) 99975 (.83

9600

3975

3600

375

Your numbers being thus placed, if you multiplie 100 *li.* by 12 moneths, you ſhall find the product to be 1200, which is your Diviſor. Then multiply 25 *li.* by 1.333, which is the Decimal of 2 *s.* 8 *d.* and the product thereof will be 33325, which multiplie again by 3, aud the product will be 99975 for your Dividend, this 99975 divided by 1200, giveth in the quotient .83, which is the Decimal of 2 *d*, which 2*d.* added to 2 *s.* 8 *d.* the price which the Ell of Lockeram coſt, giveth 2 *s.* 10 *d.* and at that price muſt you ſell the ſame at 3 moneths time

time ſo that you may gain 25 *l.* in the 100 *li.* in 12 moneths.

I might further proceed to ſhew you Examples in divers other Rules; As in *Alligation*, *Poſition*, &c. but thoſe Rules being already handled in the Firſt Part of this Book, it will be eaſie to apply them to the Scales, And (as I intimated at the beginning of this Third Part,) that although I have onely made choice of the eight Scales there mentioned and deſcribed, yet it was eaſie to contrive Scales for the Coins Weights, and Meaſures of other Countries, and not only ſo, but when the value of the Money, Weight, or Meaſure of one Countrey, and the Money, Weight, or Meaſure of another Countrey is known, it is eaſie to contrive two Scales, which facing one another, ſhall immediately tell you how many pounds in one place ſhall be equal to ſo many Crowns, or other Coin in another place, but this I do onely intimate, that ſuch as are deſirous, may fit themſelves with Scales anſwerable to their moſt neceſſary occaſions, And thus ſhall I conclude this Third Part, referring ſome things neceſſary to ſuch a work, to the Appendix following.

An

An Appendix.

Section 1.

Of Exchange of the Coins, Weights, and Meaſures of of one Countrey, with the Coins, Weights and Meaſures of another Countrey.

TO performe this Work, there is nothing required more then the Golden Rule, if firſt the Rate or Proportion between the Coins, Weights, and Meaſures of any two Countries be known which is beſt obtained by experience, rather then taken upon truſt, all that in this place I ſhall do, is onely to inſtruct the ingenious in the manner of Work, and make uſe of ſuch Rates or Proportions as I find ſet down by Mr. *Lewis Roberts* Merchant, in his Map of Commerce.

Queſtion 1.

How many Riders (each Rider containing

1 *l.*

1 *l.* 1 *s.* 2 *d.* 2 *q.* Setrling) ſhall I receive for 251 *l.* 6 *s.* 4 *d.* 2 *q.* Sterling?

Facit 237 Riders.

l.	*s.*	*d.*				*li.*	*s.*	*d.*
If 1	1	2⅓	*give* 1	*how many Riders ſhall*		251	6	4⅓ *give* ?

Here if you reduce your numbers to their leaſt Denominations, or ſet them down in Decimals, and multiplie and divide according to the Golden Rule, you ſhall find in your quotient 237, and ſo many *Riders* ought to be received for 251 *l.* 6 *s.* 4 *d.* 2 *q.* Sterling.

Queſtion 2.

How many French Crowns (each French Crown being valued at 6 s. *Sterling,) ſhall I receive for* 492 *li.* 18 *s.* Sterling?

Facit 1643 French Crowns.

s.	*F.C.*		*li.*	*s.*
If 6 *give*	1	*what ſhall*	492	18 *give*

Multiplie and divide according to the Golden Rule, and you ſhall have in your quotient 1643, and ſo many French Crowns are to be received for 492 *li.* 18 *s.* Sterling.

Queſt.

Queſtion 3.

A Merchant delivered at *Paris* 1643 Crowns of 6 *s.* Sterling the piece, how many pounds Sterling ought to be received at *London*?

Anſwer 492 *li.* 18 *s.* Sterling

Crown s. Crow.
If 1 *give* 6 *what ſhall* 1643 *give?*

Multiply and divide, and you ſhall have in your quotient 492 *l.* 18 *s.* and ſo much Sterling Money ought to be delivered at *London* for 1643 French Crowns of 6 *s.* the Crown Sterling.

Queſtion 4.

If 3 *yards at* London, *be* 4 *Ells at* Antwerpe, *how many yards at* London *make* 84 *Ells at* Antwerpe?

Ells Antwerp yards Lodon Ells Ant.
4 —— 3 —— 84

Facit 63.

And ſo many yards at *London*, are equal to 84 Ells at *Antwerp*.

Queſtion 5.

How many yards of London *make* 27 *Ells of* Antwerpe

werpe, *when* 100 *Ells of* Antwerpe *make* 60 *Ells of* Lions, *and* 20 *Ells of* Lions *make* 25 *yards of* London?

The first work.

Ells Lions *yards London* *Ells Lions*

20 ——— 25 ——— 60

60

15 c|o

75 *facit* 75

That is 75 yards of *London* is equal to 100 Ells of Antwerp.

The second Work.

Ells Antwerp *Yards Lon.* *Ells Antwerp*

100 ——— 75 ——— 27

27

525

150

20|25 *yards of London* *facit* 20.25

Question 6.

If 100 *li. Sterling be* 104 *l.* 6 *s.* 4 *d. Flemish what is one pound Sterling worth?*

li.

li. Sterl.	*li.*	*s.*	*d.*	*li. Sterl.*
100	134	6	4	1

20

2686

12

5372

26864

322|36

Facit 322 *pence* $\frac{36}{100}$ of a peny.

Queſt. 7.

How many Ells of Frankford *make* 42$\frac{1}{4}$ *Ells of* Vienna *in* Auſtria, *when* 35 *Ells of* Vienna *make* 24 *at* Lions; 3 *Ells of* Lions, 5 *Ells of* Antwerp, *and* 100 *Ells of* Antwerp, 125 *Ells at Frankford.*

Firſt Work.

Ells Ant.	*Ells Frank.*	*Ells Ant.*
100	1.25	5

5

625

Facit 6.25 or 6 Ells and a quarter of *Frankford* equal to 3 Ells of *Lions*

Second Work.

Ells Lions Ells Frank. Ells Lions

3 — 6.25 — 24

24

2500

1250

3) 150.00 (50.

15

0

Facit 50 Ells of *Frankford*, equal to 35 Ells of *Vienna*.

Ells Vien. Ells Frank. Ells Vien.

35 — 50 — 42.2

35) 2112.50 (60.35

210

125

105

200

175

25

Facit

Facit 60.35 or 6 $\frac{5}{14}$ Ells of *Frankford*, equal to 35 Ells of *Vienna*.

Thus have I given you a few Examples of Exchanges, I will now inſert ſome few Tables derived from Mr. *Lewis Roberts* his Map of commerce aforeſaid, of the truth of which, I am not a competent Judge, but ſhall leave that to the ſcrutiny of ſuch as have occaſion to trade into forreign Countries.

A Table shewing what one pound of *Avoirdupois* Weight at *London*, maketh in divers eminent Cities and, other remarkable places.

One pound of Avoirdupois *weight at* London, *makes at*

	lb.
Antwerpe	.9615
Amsterdam	.9
Abbeville	.91
Ancona	1.282
Avignon	1.12
Burdeaux	.91
Burgoyne	.91
Bollonia	1.25
Bridges	.98
Calabria	1.3698
Callais	1.07
Constantinople,	.8474 Loder;
Deepe	.91
Danfick	1.16
Ferrara	1.3333
Florence	1.282
Flanders in general,	1.06
Geneva	.9345

Genoa

One pound of Avoirdupois *weight at* London, *makes at*

	lb.
Genoa	1.4084 ſuttle
	1.4285 groſſe
Hamburg	.92
Holland	.95
Lixborne	.881
Lions	1.07 common weight
	.98 ſilke weight
	.9 cuſtomers weight
Leghorn,	1.3333
Millan,	1.4285
Mirandola,	1.3333
Norimberg	.88
Naples,	1.4084
Paris,	.89
Prague,	.83
Placentia,	1.3888
Rotchell,	1.12
Rome,	1.27
Rovan	.875 by Vicont
	.9017 common weight
Sivill,	1.08
Tholouſa,	1.12
Turin,	1.2195
Venetia,	1.5625 ſuttle
	.9433 groſſe
Vienna	.813

The uſe of the preceding Table.

How much weight at Bollonia, *will 655 l. Avoirdupois make?*

Look in the Table for *Bollonia*, and right againſt it you ſhall find 1.25, which ſheweth that one pound Avoirdupois at *London* is equal to 1.25 *l.* at *Bollonia*, Therefore ſay by the Rule of Three.

If 1 *l.* Avoirdupois give 1.25 *l.* at *Bollonia*, what ſhall 655 *li.* Avoirdupois give? *Anſwer* 818.75. As by the operation following doth appear.

li.	*li.*	*li.*
1	125	655

655
625
625
750
818.75 or $818\frac{3}{4}$

A Table shewing what one pound Weight in divers forreign Cities, and remarkable places, maketh at *London* of *Avoirdupois* Weight.

One pound weight in	makes at London of Avoirdupois weight	lb.
Antwerpe		1.04
Amsterdam		1.1111
Abbeville		1.0989
Ancona		.78
Avignon		.8928
Burdeaux		1.0989
Burgoyne		1.0989
Bollonia		.8
Bridges		1.0204
Calabria		.73
Callais		.9345
Deepe		1.0989
Dansick		.862
Ferrara		.75
Florence		.78
Flanders in general,		.9433
Geneva		1.07
Genoa subtle		.71
Genoa grosse.		.7

One pound weight in		makes at London of Avoirdupois weight	lb.
	Hamburg		1.0865
	Holland		1.0526
	Lixborne		1.135
	Lions cõmon weight		.9345
	Lions silke weight		1.0204
	Lions custom weight		1.1111
	Leghorne		.75
	Millan		.7
	Mirandola		.75
	Norimberg		1.1363
	Naples		.71
	Paris		1.1235
	Prague		1.2048
	Placentia		.72
	Rotchel		.8928
	Rome		.7874
	Rovan by Vicont,		1.1428
	Rovan cõmon weight		1.1089
	Sivill		.9259
	Tholousa		.8928
	Turin		.82
	Venetia suttle,		.64
	Venetia grosse:		1.06
	Vienna		1.23

The

The uſe of the foregoing Table.

In 7652 *li. weight at* Mirandola, *how many pound Weight at* Avoirdupois.

Look in the Table for *Mirandola*, and right againſt it you ſhall find .75, which ſheweth that one pound *Avoirdupois* is equal to .75 or $\frac{3}{4}$ of a pound at *Mirandola*, wherefore ſay by the Rule of Three.

If 1 *l.* at *Mirandola*, gives .75 or $\frac{3}{4}$ of a pound *Avoirdupois*, what ſhall 7652 *li.* of *Mirandola* give? *Anſwer* 5739, as by the operation doth appear.

li.		
1	.75	7652
		75
		38260
		53564
		573900

A Table reducing Engliſh Ells to the Meaſures of divers forreign Cities and remarkable places.

One Ell at London *makes at*

A	Mſterdam	1.6949	Ells
	Antwerp	1.6666	
	Bridges	1.64	
	Arras	1.65	
	Norimberg	1.74	
	Colen	2.08	
	Liſle	1.66	
	Maſtrich	1.57	
	Frankford	2.0866	
	Danſick	1.3833	
	Vienna	1.45	
	Paris	.95	
	Rovan	1.03	Aulns
	Lions	1.0166	
	Callais	1.57	
	Venice linnen	1.8	Braces
	Venice ſilke	1.96	
	Lucques	2.	
	Florence	2.04	
	Millan	2.3	
	Leghorn	2.	
	Madera Iſles	1.0328	

Sivill

One Ell at London, *makes at*	Sivill	1.35	
	Lisbone	1.	Vares
	Caſtillia	1.3875	Vares
	Andoluzia	1.3625	Vares
	Granado	1.3625	Vares
	Genoa	4.8083	Palmes
	Saragoſa	.55	Canes
	Rome	.56	Canes
	Barſelona	.7125	Canes
	Valentia	1.2125	Canes

The uſe of this Table.

In 632 *Ells at* London, *how many Braces at* Florence?

Look in the Table for *Florence*, and right againſt it you ſhall find 2.04, which ſheweth that one Ell at *London*, maketh at *Florence* 2.04 Braces, wherefore ſay by the Rule of Three.

If one Ell at London, *give* 2.04 *Braces at* Florence, *how many Braces ſhall* 632 *Ells give?* Anſwer 1289.28, as by the operation following doth appear.

I —— 2.04 —— 632

632

408

612

1224

1289|28

A

A Table reducing the Measures of divers forreign Cities and remarkable places, to English Ells.

One Ell at	Amsterdam	makes at London	.59	Ells
	Antwerp		.6	
	Bridges		.6097	
	Arras		.606	
	Norimberg		.5747	
	Colen		.4807	
	Lisle		.6024	
	Mastrich		.6369	
	Frankford		.4792	
	Dansick		.7228	
	Vienna		.6896	
One Aun at	Paris		1.0526	
	Rovan		.9708	
	Lions		.9836	
	Callais		.6369	
One Brace at	Venice linnen		.5555	
	Venice silke		.5102	
	Lucques		.5	
	Florence		.4901	
	Millan		.4347	
	Leghorn		.5	
	Madera Isles		.9681	

Sivill

One Vare at	Sivill	*makes at* London	.7407
	Lisbone		1.
	Caſtilia		.7207
	Andoluſia		.7339
	Granado		.7339
One Palm at *Genoa*			.2079
One Cane at	Saragoſa		1.8181
	Rome		1.7857
	Barſelona		1.4035
	Valentia		.8247

The uſe of this Table.

In 5727 *Braces at* Leghorn, *how many Ells* Engliſh.

Look in the Table for *Leghorn*, and right againſt it you ſhall find .5, which ſheweth that one Brace at *Leghorn* maketh at *London* .5 or half an Ell, wherefore ſay by the Rule of Three.

If one Brace at Leghorn *give* .5 *Ells at* London, *what ſhall* 5727 *Braces give?* Anſwer 2863.5, as by the work apeareth.

1 ——— .5 ——— 5727

.5

2863.5

Section

Section 2.

Concerning Interest and Annuities.

The first Table shewing what one pound being forborn any number of years under 31, *will amount unto, accounting interest upon interest, after the rate of* 6 per cent.

Y	6 *per cent.*	Y	6 *per cen.*	Y	6 *per cen.*
1	1,06	11	1,89829	21	3,39956
2	1,1 236	12	2,01219	22	3,60353
3	1,19101	13	2,13292	23	4,81975
4	1,26247	14	2,26090	24	4,04893
5	1,33822	15	2,39655	25	4,29187
6	1,41851	16	2,54035	26	4,54938
7	1,50363	17	2,69277	27	4,82234
8	1,59384	18	2,85433	28	5,11168
9	1,68947	19	3,02559	29	5,41838
10	1,79084	20	3,20713	30	5,74349

The

The firſt Column of this Table having *Y* at the top thereof, beginning at 1, and ſo proceeding to 30, ſignifie years, aud the numbers in the next column anſwering thereuuto do ſhew what one pound is worth, being forborn any number of years under 31, which Table is made according to this proportion.

As 100 to 106, ſo is 1 to 1.06

and again,

As 100 — 106 — 106 — 1.1236

and thirdly,

As 100 — 106 — 1.1236 — 1.19101

Et ſic ad infinitum.

The uſe of this Table.

What 136 *l.* 15 *s.* 6 *d. amount unto, being forborn* 20 *years, after the rate of* 6 per cent. *intereſt upon intereſt.*

Look in the Table for 20 years, and right againſt it in the broader column, you ſhall find 3.20713, which ſhews that one pound being forborn 20 years will be augmented to 3.20713. Then if you reduce your 136 *li.* 15 *s.* 6 *d.* into a Decimal, either by the Tables in the Second Part, or by the Scales in the Third Part of this Book,

Book, you ſhall find it to be 136.775. Wherefore ſay by the Rule of Three Direct.

If one pound being forborn 20 *years will be augmented to* 3.20713, *to how much will* 136.775 *li. be augmented to in the ſame time.* Anſwer, to 438 *li.* 13 *s.* 1 *d.* 1 *q.* as by the operation following doth appear.

li.	*li.*	*l.*
1 ———	3.207 13 ———	136.775

136.775

1603565
2244991
2244991
1924278
962139
320713

438.655 20575

Or

438 *li.* 13 *s.* 1 *d.* 1 *q.*

The Second Table, *ſheweth what one pound Annuity will amount unto, being forborn any number of years under* 31, *at* 6 per cent. *intereſt upon intereſt, the Annuity being to be paid yearly.*

Y	6 *per cent.*	Y	6 *per cen.*	Y	6 *per cen.*
1	1,00000	11	14,97164	21	39,99272
2	2,06000	12	16,86994	22	43,39228
3	3,18360	13	18,88213	23	46,99582
4	4,37461	14	21,01506	24	50,81557
5	5,63709	15	23,27596	25	54,86451
6	6,97531	16	25,67252	26	59,15638
7	8,39383	17	28,21287	27	63,70576
8	9,89746	18	30,90565	28	68,52810
9	11,49131	19	33,75999	29	73,63979
10	13 18079	20	36,78559	30	79,05818

The uſe of this Table.

What will an Annuity of 20 *l. payable yearly, be augmented unto in* 12 *years, being all that time forborn ac-*

accounting interest upon interest at 6 per Cent per Annum.

Look in the first column of the Table for 12 years, and right against it in the next Column you shall find 16,86994, which shews that 1 *li.* Annuity payable yearly, being forborn 12 years will amount unto 16.86994, wherefore say by the Rule of Three Direct,

If one pound Annuity forborn 12 *years give* 16.8694 *what shall an Annuity of* 20 *l. a year give? being forborn the same term of* 12 *years?* Answer 337 *l.* 7 *s.* 11 *d.* 3 *q. ferè*, as by the operation doth appear.

1 ——— 16.86994 ——— 20

20

337.39880

or

337 *l.* 7 *s.* 11 *d.* 3 *q. fere*

The third Table ſheweth what one pound being forborn any number of years under 31 *is worth in ready money, rebatiag yearly, after the rate of* 6 per cent· *intereſt upon intereſt.*

y	6 *per cent.*	*y*	6 *per cen.*	*y*	6 *per cen.*
1	,943396	11	,526787	21	,294155
2	,809996	12	,496989	22	,277505
3	,839619	13	,468839	23	,261797
4	,792093	14	,442300	24	,246978
5	,747258	15	,417263	25	,232998
6	,704960	16	,393646	26	,219810
7	,665057	17	,371364	27	,207367
8	,627412	18	,350343	28	,195630
9	,591898	19	,330512	29	184556
10	,558394	20	,311804	30	,174110

The making of the Table.

As — 106 — 100 — .943396 — 889996

As

and again,

As 106 — 100 — .889996 — 839619

Ee ſic ad infinitum.

If 356 *li. be payable at the end of ſeven years, what is it worth in ready money, diſcounting or rebating after the rate of* 6 per cent. *intereſt upon intereſt.*

Look in the Table for 7 years, and againſt it you ſhall find .665057, being the ready money which 1 *l.* is worth payable at 7 years end, wherefore ſay by the Rule of Three.

If 1 *l. in* 7 *years rebate or decreaſe to* .665057, *to what will* 356 *l. rebate or decreaſe in the ſame time?* Anſwer to 170 *li.* 5 *s.* 1 *d.* as by the operation doth appear.

1 ——— .665057 ——— 256

256

3990342

3325285

1330114

170.254592

or

170 *l.* 5 *s.* 1 *d.*

The

The fourth Table ſheweth the preſent worth of one pound Annuity, to continue any number of years under 31, *and payable yearly after the rate of* 6 per cent. *intereſt upon intereſt.*

Y	6 *per cent.*	Y	6 *per cen.*	Y	6 *per cen.*
1	0,94339	11	7,88687	21	11,76405
2	1,83339	12	8,38384	22	12,04158
3	2,67301	13	8,85268	23	12,30337
4	3,46510	14	9,29498	24	12,55035
5	4,21236	15	9,71224	25	12,78335
6	4,91732	16	10,10589	26	13,00316
7	5,58238	17	10,47725	27	13,01053
8	6,20979	18	10,82760	28	13,40616
9	6,80169	19	11,15811	29	13,59071
10	7,36008	20	11,46992	30	13,76482

The uſe of the Table.

What is the preſent Rent or Annuity of 25 *li.* per annum *worth payable yearly, for* 21 *years, ac-*

accounting intereſt upon intereſt at 6 per cent.

Look in the Table for 21 years, and right againſt it you ſhall find 11.76407, which is the preſent worth of one pound Annuity, for 21 years, wherefore ſay by the Rule of Three.

If an Annuity of 1 *l.* per annum *for* 21 *years be worth* 11.76407 *ready money, what is an Annuity of* 25 *li.* per annum *worth in ready money for the ſame time?* Anſwer 294 *li.* 2 *s.* 0 *d.* 1 *q.* as by the operation following doth appeear.

1 ←—— 11.76407 ——— 25

25

5882035
2352814

294.10175

or

294 *l.* 2 *s.* 0 *d.* 1 *q.*

The fifth Table ſheweth what Annuity payable yearly, one pound will purchaſe for any number of years under 31, *after the rate of* 6 per cent. *compound intereſt.*

Y	6 per cent.	Y	6 per cent.	Y	6 per cen.
1	1.06000	11	.12679	21	.08500
2	.54363	12	.11926	22	.08304
3	.37411	13	.10297	23	.08127
4	.28859	14	.10758	24	.07967
5	.23739	15	.10296	25	.07822
6	.20336	16	.09895	26	.07690
7	.17913	17	.09544	27	.07569
8	.16103	18	.09235	28	.07459
9	.14702	19	.08962	29	.07357
10	.13586	20	.08718	30	.07264

The use of this Table.

What Annuity to begin presently and to continue 28 *years. payable at yearly payments, will* 640 *l. purchase, accounting componnd interest after the rate of* 6 per cent.

Look in your Table for 28 years, a d right against it in the next column you shall find .07459, which shews that one pound ready money will purchase an Annuity worth .07459, and to continue 28 years, wherefore say by the Rnle of Three.

If one pound ready money, will purchase an Annuity worth .07459 to continue 28 *years, what annuity shall I purchase for the same time, paying* 640 *li. ready money?* Answer 47 *l.* 14 *s.* 9 *d,* as by the operation doth appear.

1 ——— .07459 ——— 640

640

29836

44754

47.77760

or

47 *l* 14 *s.* 9 *d.*

FINIS.